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ABSTRACT

This handbook for industrial educators is a resource to aid in integrating energy activities and implementing the Wisconsin Guide to Local Curriculum Improvement in Industrial Education, K-12. Section 1 includes examples of three curriculum outlines: A Curriculum Guideline for Energy and Power: Power and Energy--Shawano IECP Project Curriculum Outline: and Technical Systems Inc. Curriculum Flow Chart and Course Outlines. Section 2 contains learning activities. The first part is an Energy Activity Guide divided into five areas: uses, sources, conversion, impacts, and limits of energy. The next part, student projects, includes a list of various power and energy hands-on products for Grades K-12. Most can be modified to fit any level. Projects can be bought commercially or be built from parts and pieces readily available. Part 3 describes teacher activities, such as field trips, special speaker suggestions, lectures, teaching hints, and group activities related to power and energy. Part 4 provides additional student activities. The final section of the handbook lists resources on developing an industrial education program: films, teacher's resource list, booklets, and people. A bibliography includes an annotated childrens bibliography (Grades 4-6), annotated teacher's bibliography, and Federal Energy Administration Annotated List of Educational Materials and Programs. (YLB)

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HANDBOOK

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THE WISCONSIN GUIDE TO
LOCAL CURRICULUM IMPROVEMENT
IN INDUSTRIAL EDUCATION, K-12

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PREFACE

This handbook is intended to aid industrial educators in developing energy activities into their programs. The Energy Handbook is not a course of study, but rather a resource to aid in local program improvement. It is designed to be used by educators to aid them in implementing The Wisconsin Guide to Local Curriculum Improvement in Industrial Education, K-12.

The content outlines, models, structures and activities can be utilized for courses, specific units or for integrating energy concepts throughout the industrial education program.

The materials included in this handbook come from a number of excellent resources that have been developed to improve energy education. Where the sources were known, credit is given for inclusion.

Mr. Fred Beyer
Shawano High School
Shawano, Wisconsin

Mr. Alan Curry
University of Wisconsin-Stout
Menomonie, Wisconsin

Mr. Keith B. Kroma
Chippewa Falls High School
Chippewa Falls, WI 54729

Dr. Jack B. Sampson (Consultant and Editor)
Energy and Transportation Department
University of Wisconsin-Stout
Menomonie, Wisconsin 54751

Problems related to energy are present today, and will be here in the future. These energy problems will cause many changes in industry, lifestyles, and the environment. Since industrial education is the study of society and industry, industrial education should emphasize the study of energy. This study should include the following aspects of energy: Forms, sources, storage, conversion, transmissions, conservation, availability, controls, and measurement.

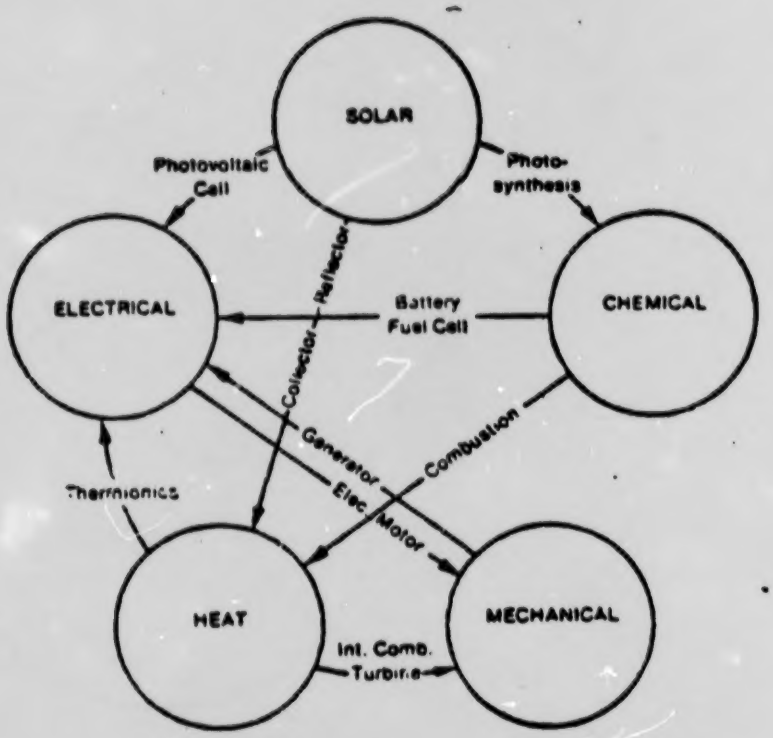
RATIONALE:

A rationale is a reason for existence or prepared action. In curriculum development it answers the key question of "why" something is taught.

A rationale is thus a justification statement which highlights the importance of the program, course, or unit which it is directed at.

The statement is generally short, concise, and directly to the point. The rationale that follows in this resource handbook provides the user with a set of ideas to use in developing a statement for local use.

ENERGY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Photovoltaic Cell
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Reflector
Generator
Elec. Motor
Combustion
Thermionics
HEAT
MECHANICAL
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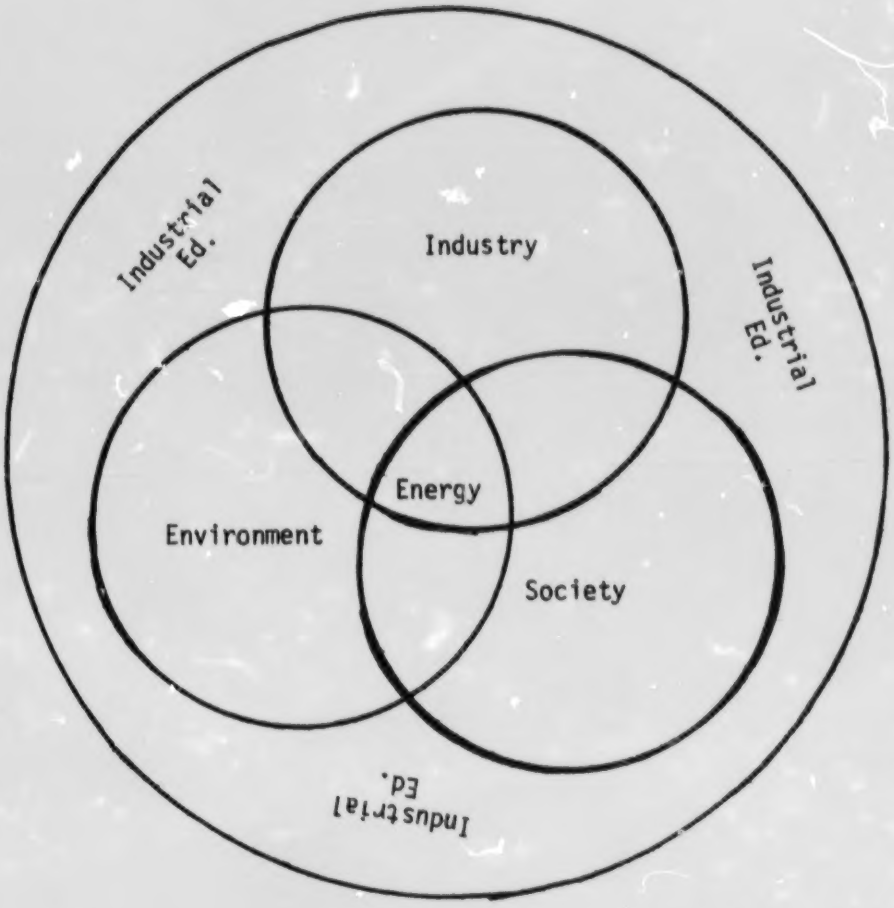

Industrial Ed.
Industry
Industrial Ed.
Energy
Environment
Society
Industrial Ed.

CONTENT OUTLINES:

Content in any curriculum area can be structured in many different ways. In addition, the manner in which the content overview is communicated to other professionals can take on a variety of approaches.

Common approaches for communicating a curriculum structure, scope, and sequence are usually in the form of outlines, models, or a combination of the two.

The content structures that follow in this handbook are examples of different ways of communicating the subject to the profession.

Included in the content outlines are examples of four curriculum outlines.

A. Curriculum guidelines for power and energy from the National Educational Council on Energy and Power

B. Power and energy; Shawano IECP Project Curriculum Outline

C. Technical Systems, Inc., (St. Paul, MN) Curriculum Flow Chart and Course Outlines

D. Energy Activity Guide (outline) by Energy and Mans Environment 0224 SW Hamilton, Suite 301, Portland, Oregon 97201

A

CURRICULUM

GUIDELINE

FOR

ENERGY

and

POWER

Vahan V. Basmajian

Mr. Basmajian has been the president of Megatech Corporation, Billerica, Mass. and Founder since 1970. He is well known as a researcher, inventor and analyst in the field of energy and power. Presently, he is dedicated to introducing new software and hardware to the educational institutes in the field of energy and power, and is undertaking basic research for new educational devices.

Mr. Basmajian has been the author of several technical papers. He has been a researcher at M.I.T. and is a graduate of the same institute with a Master of Science degree.

A CURRICULUM GUIDELINE FOR ENERGY AND POWER

The author is a curriculum committee member of the National Educational Council on Energy and Power (NECEP), whose members are engaged in the development of a national curriculum model. Mr. Basmajian has been conducting similar activities with Virginia Polytechnic Institute and has been writing a course program on Energy and Power.

This article represents a course outline derived from the flow charts as published in the April, 1976 issue of Energy & Power Journal, Page 25. It is hoped that this article will give further details and guidelines to school administrators and educators as to the scope and magnitude of an Energy and Power program.

* Coprighted, 1977

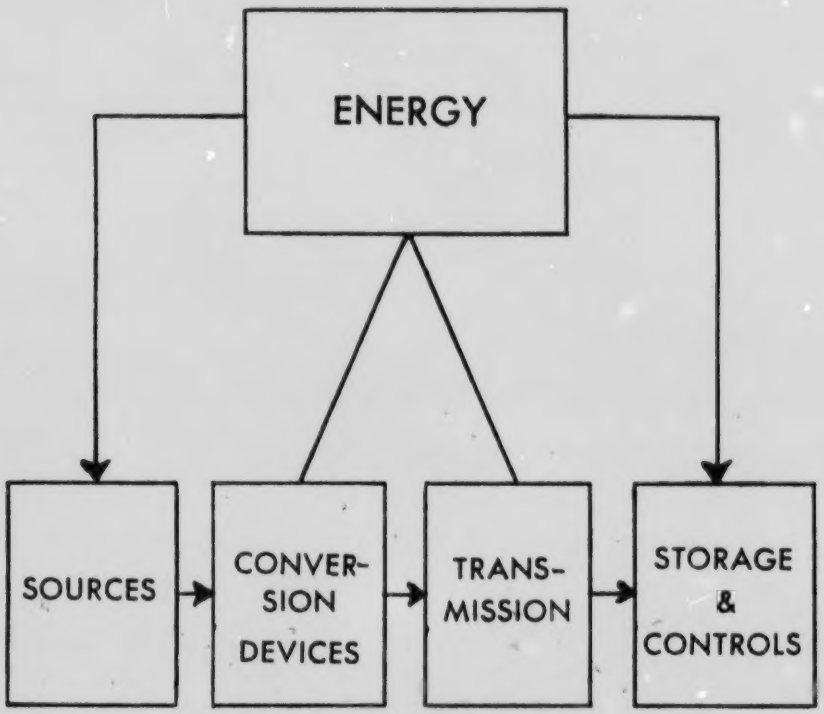
Reprints of this article are
available from NECEP,
P.O. Box 618, Concord, Mass.
Price: $1.99

The energy related social, economic and political upheavals in the U.S. and world wide have added a new dimension and new responsibilities for educators. Certainly, the most important concern is preparing the students of today for the energy conditions that will exist tomorrow.

The Nation's energy demand for the future and the declining supply of fossil fuels indicate clearly a need for a new emphasis on alternate energy systems. Federal, Industrial or Research Agencies conducting an energy analysis all agree on one matter . . . the ultimate solution of U.S. energy shortages depends on the development of alternate energy sources. For this reason, education has to play an important role in the transition from traditional "power technology" programs that are essentially small engine programs into those inclusive of alternate energy sources.

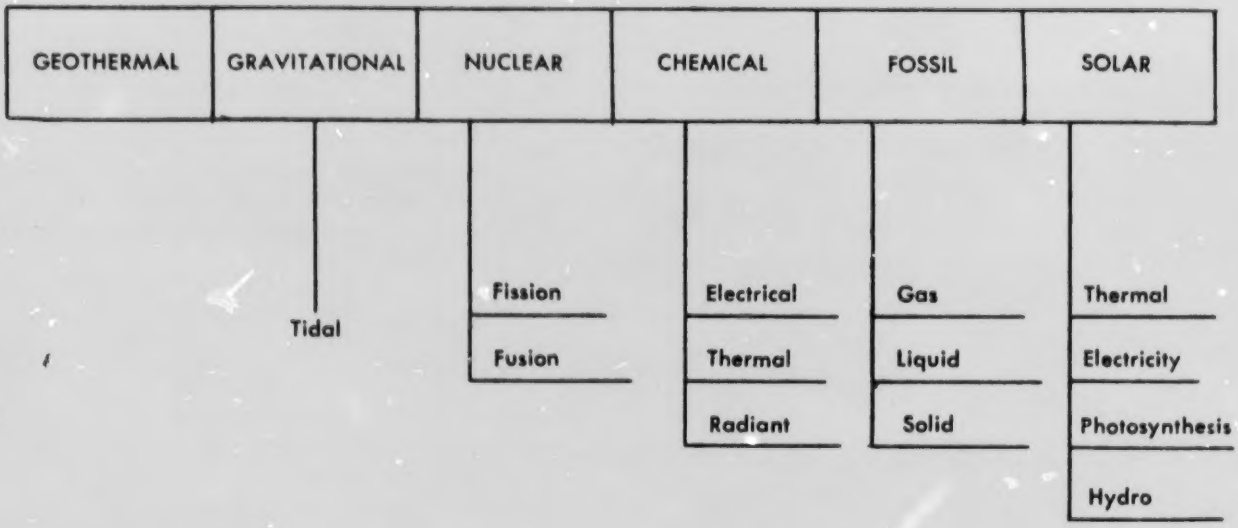
The student needs to be able to relate new energy sources to devices that can produce power. Additionally, he must develop an awareness of the emerging occupations in this field. A well planned curriculum with the proper hardware and software will be the beginning of a transitional period of growth as the student develops new career awareness. It is imperative that a curriculum be structured modularly and with continuity. He must be able to follow the program through various levels and achieve the prescribed competency levels. No doubt an Energy and Power Curriculum model must offer the student an awareness, orientation, exploration and preparation sequence.

It is hoped that the following model can serve as a basis for the above objectives and assist educators and administrators in making their decisions as how best to serve the needs of the students and the nation.



ENERGY FLOW CHART

The above energy flow chart indicates the interrelationship which exists between energy sources, conversion devices, transmission, storage and controls. In order for the student to develop total energy awareness for energy and power, in a given area of a laboratory he must be able to explore the various sources of energy and the corresponding conversion systems. Upon producing power, the student certainly must be aware of the various methods by which power is transmitted and stored.



ENERGY SOURCES

PRIMARY ENERGY SOURCES

The above chart indicates the primary energy sources which have the greatest potential in the development of U.S. alternate energy supplies. There are secondary sources which are dependent on the primary sources. These are not listed since the major emphasis during the next twenty five years will be placed on the above listed energy sources. The student's awareness and exploration must be directed towards the primary sources of energy. New emerging occupations and careers that are a direct result of the development of these energy sources must be brought to the student's attention.

ENERGY SOURCES

A. THE NATURE OF ENERGY AND POWER

1. Concept of energy
2. Definition of energy, work and power
3. Relationship between different forms of energy

B. FOSSIL FUELS

1. History of fossil fuels utilization
2. Formation of fossil fuels
3. The availability of fossil fuels in the U.S. and the world
4. Consumption of fossil fuels for transportation, commercial, industrial and residential purposes
5. Production of power from fossil fuels

6. Advantages and disadvantages of fossil fuels
7. Fossil fuels as chemical raw materials
8. Environmental Impact
9. Career opportunities

C. RADIOACTIVE MATERIALS

1. Nature of atom
2. Explanation of nuclear reactions (fission and fusion)
3. How a nuclear reaction can be used to produce power
4. Uranium mining
5. Availability of uranium in the U.S.
6. The advantages and disadvantages of nuclear energy
7. The role of nuclear fuels in the utility industry
8. Environmental Impact
9. Career opportunities

D. HYDRO

1. Hydro Power, its history and origin
2. Availability
3. How it can be used to produce power
4. Applications for industrial use
5. Advantages and disadvantages of its use
6. The role of hydro power stations for the generation of electricity
7. Environmental Impact
8. Career Opportunities

E. SOLAR

1. Explanation of Solar Power
2. Historical utilization
3. Its applications for heating and air conditioning
4. Its advantages and disadvantages as an alternate source of energy
5. The role of solar power in the future
6. Environmental Impact
7. Career Opportunities

F. WIND

1. Explanation of how the winds are produced
2. History of their use
3. Power generation from wind
4. Advantages and disadvantages
5. The role of wind power for the nation's future energy needs
6. Environmental Impact
7. Career Opportunities

G. GEOTHERMAL

1. Description of geothermal energy source
2. Location of geothermal energy sources
3. Power production of geothermal sources
4. Advantages and disadvantages
5. The role of geothermal power for the nation's future energy needs
6. Environmental Impact
7. Career Opportunities

ENERGY CONVERSION DEVICES

INTERNAL COMBUSTION ENGINES

Traditionally the internal combustion engine has been the prime mover of the transportation industry and this sector consumes approximately 25% of the oil in the United States. The nation is 92% dependent on fossil fuels; yet these are the very sources that are depleting rapidly. Greater awareness and emphasis should be placed on alternate energy sources and conversion devices which could reduce the dependence on fossil fuels. The student must develop an awareness and explore various methods of power conversion systems. New career opportunities must be sighted where these industries are growing rapidly.

I. RECIPROCATING 2 & 4 CYCLE SPARK IGNITION ENGINES

A. HISTORICAL DEVELOPMENT OF INTERNAL COMBUSTION ENGINES

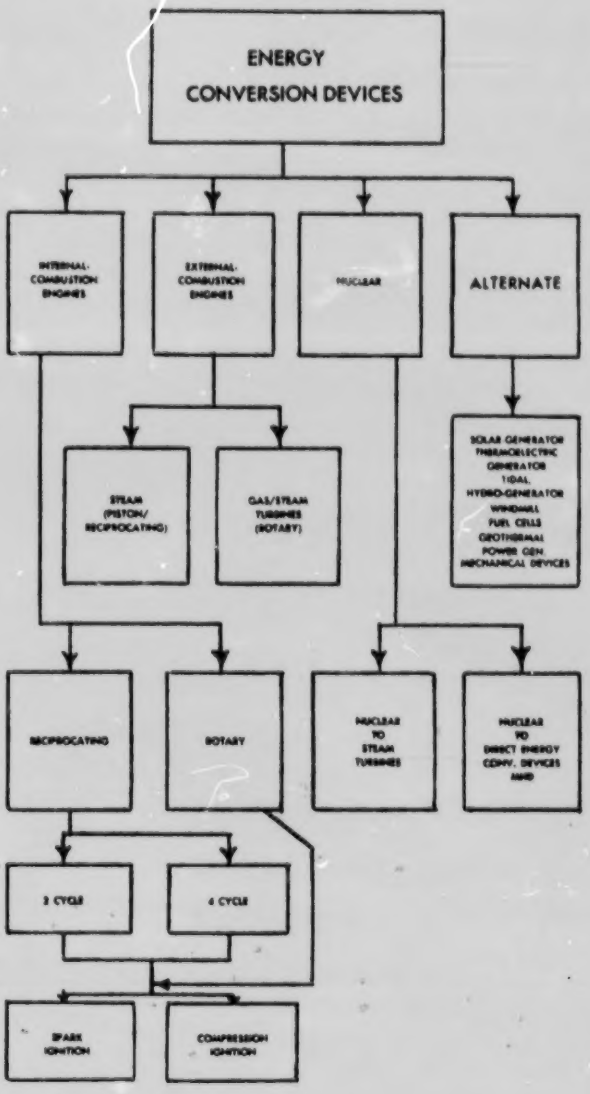
B. SAFETY IN THE LABORATORY

C. TWO AND FOUR STROKE (CYCLE) ENGINES

1. Fundamental Mechanics of 2 & 4 Cycle Engines
2. Learning the Components and Subsystems of 2 and 4 Cycle Engines
   - (a) Piston & Rings
   - (b) Carburetor and Power Control
   - (c) Connecting Rod
   - (d) Wrist Pin and Journals
   - (e) Crankshaft and Crank Gear
   - (f) Camshaft and Cam Gear
   - (g) Engine Main Bearings
   - (h) Cylinder Heads
   - (i) Valves
   - (j) Rocker Arms and Lifters
   - (k) Spark Plug
   - (l) Points and Condenser
   - (m) High Voltage Coil
   - (n) Ignition Power Source
   - (o) Flywheel
   - (p) Engine Block

D. OPERATION OF 2 & 4 CYCLE ENGINES

1. Starting Systems
   - (a) Rope Start
   - (b) Recoil Start
   - (c) Starter Motors
2. Operation
   - (a) Start up Procedures
   - (b) Operating Controls



ENERGY CONVERSION DEVICES

E. POWER CONTROL
1. Function of a Carburetor
2. Principles of operation of Venturi type Carburetors
3. Air/Fuel Mixture Ratio
4. Various types of Carburetors
   (a) Float
   (b) Diaphram
   (c) Overflow
5. Filters

F. IGNITION
1. Types of ignition systems
   (a) Battery-Coil
   (b) Magneto
2. Definition of ignition timing
3. How to Read Ignition Timing
4. How to Vary Ignition Timing
5. Relationship of Piston position to spark plug firing
6. Effect of Ignition Timing on Engine Power

G. COMPRESSION
1. Definition of Compression Ratio
2. How to Vary Compression Ratio
3. Effect of Compression Ratio on Engine Power
4. Effect of Compression Ratio on Engine Exhaust

H. COOLING SYSTEM
1. Need for Engine Cooling
2. Types of Cooling
   (a) Air Cooling
   (b) Water Cooling

I. LUBRICATION
1. Need for Lubrication
2. Types of Lubrication Systems
   (a) Splash
   (b) Spray
   (c) Pressure

J. DYNAMOMETERS
1. Connecting Engines to Dynamometers
2. Definition of Torque and Horsepower
3. Operating Principles of Electric Dynamometers
4. Operating Principles of Hydraulic Dynamometers
5. Operating Principles of Prony Brake Dynamometers
6. Operation of Electric Dynamometer/Generators
   (a) Starting Mode
   (b) Loading the Engine
   (c) Electric Power Generation

K. PERFORMANCE OF 4 CYCLE ENGINES
1. Measuring Horsepower output
2. Factors affecting Power Output

L. PERFORMANCE OF 2 CYCLE ENGINES
1. Measuring Horsepower Output
2. Comparisons of 2 & 4 Cycle Engines

M. APPLICATIONS
1. Single Cylinder
2. Multi-Cylinder

N. ENVIRONMENTAL ASPECTS
1. Emissions of 4 Cycle Engines
2. Emissions of 2 Cycle Engines

P. CAREER OPPORTUNITIES

II. RECIPROCATING 2 & 4 CYCLE COMPRESSION IGNITION ENGINES

A. HISTORICAL DEVELOPMENT OF DIESEL ENGINES

B. SAFETY IN THE LABORATORY

C. OPERATING PRINCIPLES OF 4 CYCLE DIESEL ENGINES

D. OPERATING PRINCIPLES OF 2 CYCLE DIESEL ENGINES

E. FUEL INJECTION SYSTEMS OF DIESEL ENGINES
1. Common Rail System
2. Jerk Pump System

F. FUEL INJECTORS
1. Variable Piston Stop Type
2. Variable Lifter Type
3. Bosch type

G. DIESEL FUEL

H. COMBUSTION PROCESS IN A DIESEL ENGINE

I. OPERATION OF A DIESEL ENGINE
1. Cold Start
2. Warm Start
3. Power Control

J. LOADING AND POWER MEASUREMENT
1. Connecting Engine to Dynamometer
2. Torque
   (a) Definition
   (b) How it is Measured
3. Horsepower
   (a) Definition
   (b) How it is Calculated
4. Efficiency

K. PERFORMANCE
1. How Throttling is Achieved
2. Relationship of Air/Fuel Ratio and Load
3. Relationship of Injector Timing and Power Output

L. DIESEL ENGINE MAINTENANCE
1. Fuel System
   (a) Injector
   (b) Injection Pump
2. Cylinder and Head

M. COMPARISON OF DIESEL AND SPARK IGNITION ENGINES

N. APPLICATIONS
1. Single Cylinder
2. Multi-Cylinder

O. ENVIRONMENTAL ASPECTS
1. Emissions of Diesels
2. Comparison with Spark Ignition Engines and its Effect on the Environment

P. CAREER OPPORTUNITIES

III. ROTARY ENGINES

A. HISTORICAL BACKGROUND OF ROTARY ENGINES AND COMPARISON TO RECIPROCATING ENGINES

B. SAFETY IN THE LABORATORY

C. THE WANKEL ENGINE
1. Fundamental Principles of Operation
2. Identifying the Components and Subsystems
   (a) Rotor and Seals
   (b) Carburetor and Power Control
   (c) Mainshaft and Eccentric
   (d) Housing
   (e) Side Plates
   (f) Flywheel
   (g) Spark Plug
   (h) Magneto

D. POWER CONTROL IN ROTARY ENGINES
1. Function of Carburetor
2. Principles of Carburetor Operation
3. Air/Fuel Mixture Ratio
4. Types of Carburetors
   (a) Float
   (b) Diaphram
   (c) Overflow

E. OPERATION UNDER LOAD
1. Connecting Engine to Dynamometer
2. Operation of Engine
   (a) Cold Start
   (b) Warm Start
   (c) Throttle Control
3. Operation of Electric Dynamometer/Generator
   (a) Principles of Operation
   (b) Starting Mode
   (c) Loading the Engine
   (d) Electric Power Generation
4. Operation of a Hydraulic Dynamometer

F. POWER MEASUREMENTS
1. Torque
   (a) Definition
   (b) How it is measured
2. Horsepower
   (a) Definition
   (b) How it is Calculated
3. Efficiency

G. FUELS AND MIXTURES
1. Connecting flow meters
2. Definition of Air/Fuel Mixtures
3. Effect of Mixtures on Engine Power
4. Effect of Various Fuels on Engine Power
5. Efficiency

H. COMPARISON OF ROTARY AND RECIPROCATING ENGINES

I. APPLICATIONS
1. Single Rotor
2. Multi-rotor

J. ENVIRONMENTAL ASPECTS
1. Emissions of Rotary
2. Comparison with Reciprocating Engines and its Effect On the Environment

K. CAREER OPPORTUNITIES

EXTERNAL COMBUSTION ENGINES

I. **STEAM TURBINE GENERATOR**
- A. FUNDAMENTAL PRINCIPLES OF OPEN CYCLE STEAM TURBINES
- B. SAFETY IN THE LABORATORY
- C. COMPONENTS AND SUBSYSTEMS OF STEAM TURBINE GENERATORS
  1. Steam Generating System
     (a) Heat Source and Controls
     (b) Boiler
     (c) Preheater Coil
     (d) Superheater
     (e) Steam Exhaust
  2. Energy Conversion Systems
     (a) Turbine Wheel
     (b) Electrical Generator
  3. System Loads
     (a) Fixed Resistors
     (b) Variable Resistors
- D. POWER OUTPUT
  1. How to Measure Power Output
  2. How to Vary Power Output
  3. Relationship of Output Power and Load
  4. Relationship of Output Power and Input Steam Pressure
- E. APPLICATIONS
- F. ENVIRONMENTAL ASPECTS
- G. CAREER OPPORTUNITIES

II. **RECIPROCATING STEAM ENGINES**
- A. FUNDAMENTAL PRINCIPLES OF OPEN CYCLE RECIPROCATING STEAM ENGINES
- B. SAFETY IN THE LABORATORY
- C. COMPONENTS AND SUBSYSTEMS OF RECIPROCATING STEAM ENGINES
  1. Steam Generating System
  2. Energy Conversion System
     (a) Piston-Cylinder
     (b) Valve Train
     (c) Connecting Rod
     (d) Crankshaft
     (e) Flywheel
- D. APPLICATIONS
- E. ENVIRONMENTAL ASPECTS
- F. CAREER OPPORTUNITIES

NUCLEAR POWER GENERATION

I. **ATOMIC REACTION AS HEAT SOURCE**

II. **SAFETY IN THE LABORATORY**

III. **NUCLEAR POWER GENERATORS**
- A. FUNDAMENTAL PRINCIPLES OF A CLOSED LOOP STEAM CYCLE
- B. COMPONENTS AND SUBSYSTEMS OF A NUCLEAR POWER GENERATION SYSTEM
  1. Steam Generating System
     (a) Reactor and Control Rods
     (b) Superheat and Its Control
     (c) Condenser
     (d) Reheater System
     (e) Water Pumps and Controls
  2. Energy Conversion Systems
     (a) Turbine Wheel
     (b) Electrical Generator
  3. System Loads
     (a) Fixed Resistors
     (b) Variable Resistors
- C. POWER OUTPUT
  1. How to Measure Output Power
  2. How to Vary Output Power
  3. Relationship of Output Power and Load
  4. Relationship of Output Power and Input Steam Pressure
- D. APPLICATIONS
- E. ENVIRONMENTAL ASPECTS
- F. CAREER OPPORTUNITIES

ALTERNATE ENERGY SOURCES

I. SOLAR ENERGY

A. INTRODUCTION TO SOLAR RADIATION AS A DIRECT SOURCE OF ENERGY
   1. Geographic Distribution of Solar Energy Input
   2. Solar Flux at Various Parts of the Day and Night Cycle

B. SAFETY IN THE LABORATORY

C. SOLAR-ELECTRIC GENERATOR
   1. Fundamental principles of operation of Silicon Solar Cells
   2. Components and Subsystems of a Solar-Electric Generator
      a. Sources of Energy
         1. Natural - Sun
         2. Artificial - High Density Lamp
      b. Energy Conversion Systems
         1. Silicon Solar Cell Array
         2. Other, Crystals
      c. System Loads
         1. Resistors
         2. Batteries
         3. Electro-Mechanical
   3. Power Output, Solar Electric Generators
      a. How to Measure the Output Power
      b. How to Vary the Output Power
      c. Relationship of Output Power and Load
      d. Relationship of Output Power and Light Density
      e. Relationship of Output Power and Distance from Light Source
   4. Applications
   5. Environmental Aspects
   6. Career Opportunities

D. SOLAR-THERMAL SYSTEM
   1. Fundamental principles of operation of solar thermal systems
   2. Components and Subsystems of a solar-thermal system
      a. Energy Conversion
         1. Solar Collector
            (a) Types of Collectors
            (b) Insulation
            (c) Paint Selection
            (d) Glass Covering
         2. Plumbing System
            (a) Pumps
            (b) Tubing-Fittings
   3. Operation and Controls
   4. Applications
   5. Environmental Aspects
   6. Career Opportunities

II. WIND POWER

A. INTRODUCTION TO WIND AS A SOURCE OF ENERGY

B. SAFETY IN THE LABORATORY

C. WIND POWER GENERATION

1. Fundamental principles of operation of a wind power generator
2. Components and subsystems of a wind power generator
   a. Energy conversion System
      1. Windmill types
      2. Mechanical Drives
      3. Electric Generator
   b. System Loads
      1. Resistors
      2. Batteries
      3. Output Power
         (a) How to Measure the Output Power
         (b) How to Vary the Output Power
         (c) Relationship of Output Power and Load
         (d) Relationship of Output Power and Wind Velocity

D. APPLICATIONS

E. ENVIRONMENTAL ASPECTS

F. CAREER OPPORTUNITIES

III. HYDRO POWER

A. INTRODUCTION TO FLOWING WATER AS A SOURCE OF ENERGY

B. SAFETY IN THE LABORATORY

C. HYDRO ELECTRIC POWER GENERATION

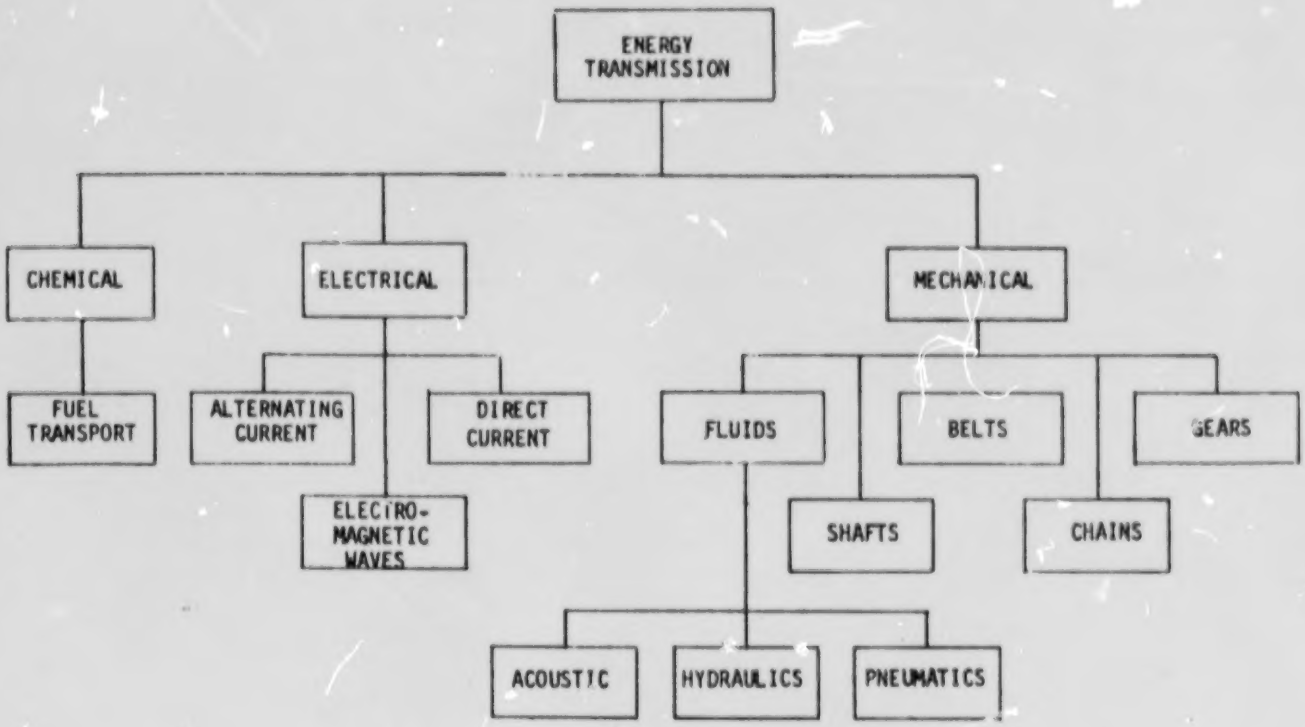
1. Fundamental principles of operation of a Hydro-Electric Generator
2. Components and subsystems of a Hydro-Electric Generator
   a. Water System
      1. Supply and controls
      2. Discharge
   b. Energy Conversion Systems
      1. Types of nozzles
      2. Types of turbine wheels
      3. Electric generator
   c. System Loads
      1. Resistors
      2. Electro-mechanical
3. Output Power
   a. How to Measure the Output Power
   b. How to Vary the Output Power
   c. Relationship of Output Power and Load
   d. Relationship of Output Power and Input Water Pressure

D. APPLICATIONS

E. ENVIRONMENTAL ASPECTS

F. CAREER OPPORTUNITIES

ENERGY TRANSMISSION



VARIOUS METHODS OF ENERGY & POWER TRANSMISSION

The power transmission industry has long been concerned with the cost of power distribution especially when the primary supply of energy is at long distances from the point of distribution. The primary method of transmitting power has been through solid conductors through alternating current.

Solar energy transmission from outer space has seriously been considered as a means of un-interrupted power through microwave beams. The industrial applications of microwaves and lasers have been established and are the most rapidly growing areas. Student awareness and exploration in the laboratory must highlight new emerging technologies and careers.

I. MECHANICAL ENERGY TRANSMISSION

A. HISTORICAL DEVELOPMENT OF BASIC MACHINES

B. SAFETY IN THE LABORATORY

C. BASIC UNITS
1. Force
2. Torque
3. Work
4. Speed
   (a) Linear
   (b) Rotary
5. Power

D. BASIC DEVICES FOR TRANSMISSION OF MECHANICAL ENERGY
1. Shafts
2. Gears
3. Belts
   (a) Ropes
   (b) Flat
   (c) Vee
   (d) Polyvee
   (e) Gear
4. Chain

E. APPLICATIONS

F. ENVIRONMENTAL ASPECTS

G. CAREER OPPORTUNITIES

II. ELECTRICAL ENERGY TRANSMISSION

A. HISTORICAL BACKGROUND OF ELECTRICITY AND ITS USE

B. SAFETY IN THE LABORATORY

C. FUNDAMENTALS OF ELECTRICITY
1. Origin of Electric Current
   (a) Matter
   (b) Atomic Structure
   (c) Electron flow
   (d) Conductors and Insulators
2. Circuits
   (a) Definitions
   (b) Laws
   (c) Power Measurements
   (d) Power Controls
   (e) Method of Transmission
   (f) Energy Storage

D. DIRECT CURRENT TRANSMISSION

E. ALTERNATING CURRENT TRANSMISSION
1. Low Voltage Power Transmission
2. High Voltage Power Transmission, transformers

F. APPLICATIONS

G. ENVIRONMENTAL ASPECTS

H. CAREER OPPORTUNITIES

III. HYDRAULIC ENERGY TRANSMISSION

A. INTRODUCTION TO HYDRAULIC SYSTEMS

B. SAFETY IN THE LABORATORY

C. HYDRAULIC FUNDAMENTALS
1. Measuring pressure
   (a) Units
   (b) Symbols
2. Transmission of force through a fluid
3. Force-Pressure Area relationship
4. Flow Measurement
   (a) Rate
   (b) Velocity
5. Work

D. HYDRAULIC PUMPS—TRANSMISSION OF FLUID ENERGY
1. Basic Types
2. Components and their functions
3. Flow rates

E. BASIC HYDRAULIC SYSTEM COMPONENTS
1. Pipes
2. Connectors
3. Filters
4. Control Valves
5. Actuators
   (a) Linear
   (b) Rotary
6. Seals
7. Type of Circuits
   (a) Series
   (b) Parallel

F. APPLICATIONS

G. ENVIRONMENTAL ASPECTS

H. CAREER OPPORTUNITIES

IV. PNEUMATIC ENERGY TRANSMISSION

A. INTRODUCTION TO PNEUMATIC SYSTEMS

B. SAFETY IN THE LABORATORY

C. PNEUMATICS FUNDAMENTALS

1. Measuring pressure
   (a) Units
   (b) Symbols
2. Flow meters
3. Compressibility
   (a) Heat of compression
   (b) Condensed Water

D. COMPRESSORS

1. Basic Types
2. Components and their functions
3. Flow rates and capacities

E. BASIC PNEUMATIC SYSTEM COMPONENTS

1. Pipes
2. Connectors
3. Filters
4. Control Valves
5. Actuators
   (a) Linear
   (b) Rotary
6. Water Separators

F. COMPARISON TO HYDRAULIC SYSTEMS

1. Response time
2. Power - density
3. Tank energy storage

G. APPLICATIONS

H. ENVIRONMENTAL ASPECTS

I. CAREER OPPORTUNITIES

V. ACOUSTIC ENERGY TRANSMISSION

A. INTRODUCTION TO ACOUSTICS AND THEIR USES

B. SAFETY IN THE LABORATORY

C. ACOUSTIC TRANSMISSION SYSTEMS

1. Fundamental principles of operation
2. Components and subsystems of an acoustic transmission system
   a. Energy transmission system
      1. Power Supply
      2. Sonic Transmitter
   b. Energy Reception system
   c. System Loads
3. Energy Transmission
   (a) Measurement of transmitted power
   (b) Measurement of received power
   (c) Relationship of transmitted power and received power
   (d) Relationship of received power and angle between transmitter and receiver
   (e) Relationship of received power and distance between transmitter and receiver
   (f) The effect of various obstacles in the beam
   (g) Transmission losses

D. APPLICATIONS

E. ENVIRONMENTAL ASPECTS

F. CAREER OPPORTUNITIES

VI. LASER ENERGY TRANSMISSION

A. INTRODUCTION TO LASERS AND THEIR USES

B. SAFETY IN THE LABORATORY

C. LASER TRANSMISSION SYSTEMS

1. Fundamental principles of operation of laser energy transmission systems
2. Components and subsystems of the laser transmission system
   - (a) Power Source
   - (b) Energy transmission system
     1. Power Supply
     2. Laser
   - (c) Energy reception system
   - (d) System Loads
3. Energy Transmission
   - (a) Measurement of transmitted power
   - (b) Measurement of received power
   - (c) Relating the input power to output power
   - (d) Relating power received and distance between transmitter and receiver
   - (e) Relating power received and angle between transmitter and receiver
   - (f) The effect of various obstacles in the beam
   - (g) Transmission losses

D. APPLICATIONS

E. ENVIRONMENTAL ASPECTS

F. CAREER OPPORTUNITIES

VII. MICROWAVE ENERGY TRANSMISSION

A. INTRODUCTION TO MICROWAVES AND THEIR USES

B. SAFETY IN THE LABORATORY

C. MICROWAVE TRANSMISSION SYSTEMS

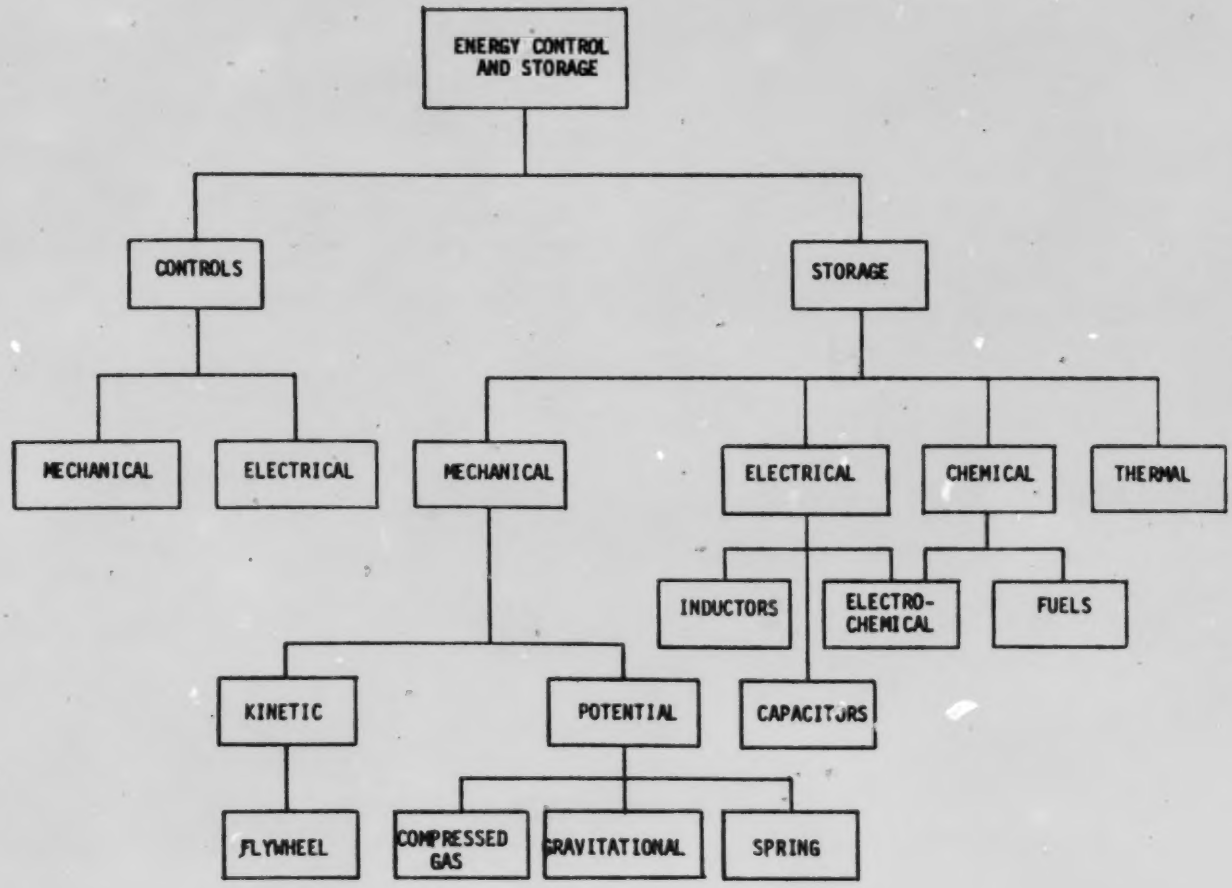
1. Fundamental principles of operation of microwave transmission systems
2. Components and subsystems of a microwave transmission system
   - (a) Energy transmission
     1. power supply
     2. microwave transmitter
   - (b) Energy reception system
   - (c) System Loads
3. Energy transmission
   - (a) Measurement of transmitted power
   - (b) How to vary transmission power
   - (c) Measurement of received power
   - (d) Relationship of power transmitted and power received
   - (e) Power variation due to angle between transmitter and receiver
   - (f) Power variation due to distance between transmitter and receiver
   - (g) The effect of various obstacles in the beam
   - (h) Transmission losses

D. APPLICATIONS

E. ENVIRONMENTAL ASPECTS

F. CAREER OPPORTUNITIES

ENERGY CONTROL AND STORAGE



The success of solar energy applications depends on methods of developing large energy storage systems which can store energy for long periods of time without the problems of corrosion and degradation. Similarly the success of an electric powered vehicle depends on the development of new types of energy storage systems. The student must be able to develop such awareness and explore various techniques of energy storage in a laboratory. New emerging occupations and careers must be highlighted and brought to the student's attention.

ENERGY CONTROL AND STORAGE

I. ENERGY STORAGE
- A. INTRODUCTION TO ENERGY STORAGE
- B. SAFETY IN THE LABORATORY
- C. TYPES OF STORAGE
  1. Electrical Energy
     - (a) Capacitors
     - (b) Inductors
  2. Mechanical Energy
     - (a) Flywheels
     - (b) Position - gravitational
     - (c) Spring tension - compression
     - (d) Compressed gasses
  3. Thermal
     - (a) Hot Mass
     - (b) Evaporation - condensation
     - (c) Fusion - solidification
  4. Chemical
     - (a) Fuels
     - (b) Batteries
- D. APPLICATIONS
- E. ENVIRONMENTAL ASPECTS
- F. CAREER OPPORTUNITIES

II. ENERGY CONTROL
- A. INTRODUCTION TO ENERGY CONTROL
- B. SAFETY IN THE LABORATORY
- C. TYPES OF CONTROL
  1. Electrical
     - a. Electro-magnetic
       1. Polarization
       2. Electrostatic
     - b. Electro-mechanical
       1. Solenoids
       2. Relays
  2. Mechanical
     - (a) Clutches
     - (b) Brakes
     - (c) Transmissions
  3. Fluid
     - (a) Valves
     - (b) Regulators
- D. APPLICATIONS
- E. ENVIRONMENTAL ASPECTS
- F. CAREER OPPORTUNITIES

POWER

AND

ENERGY;

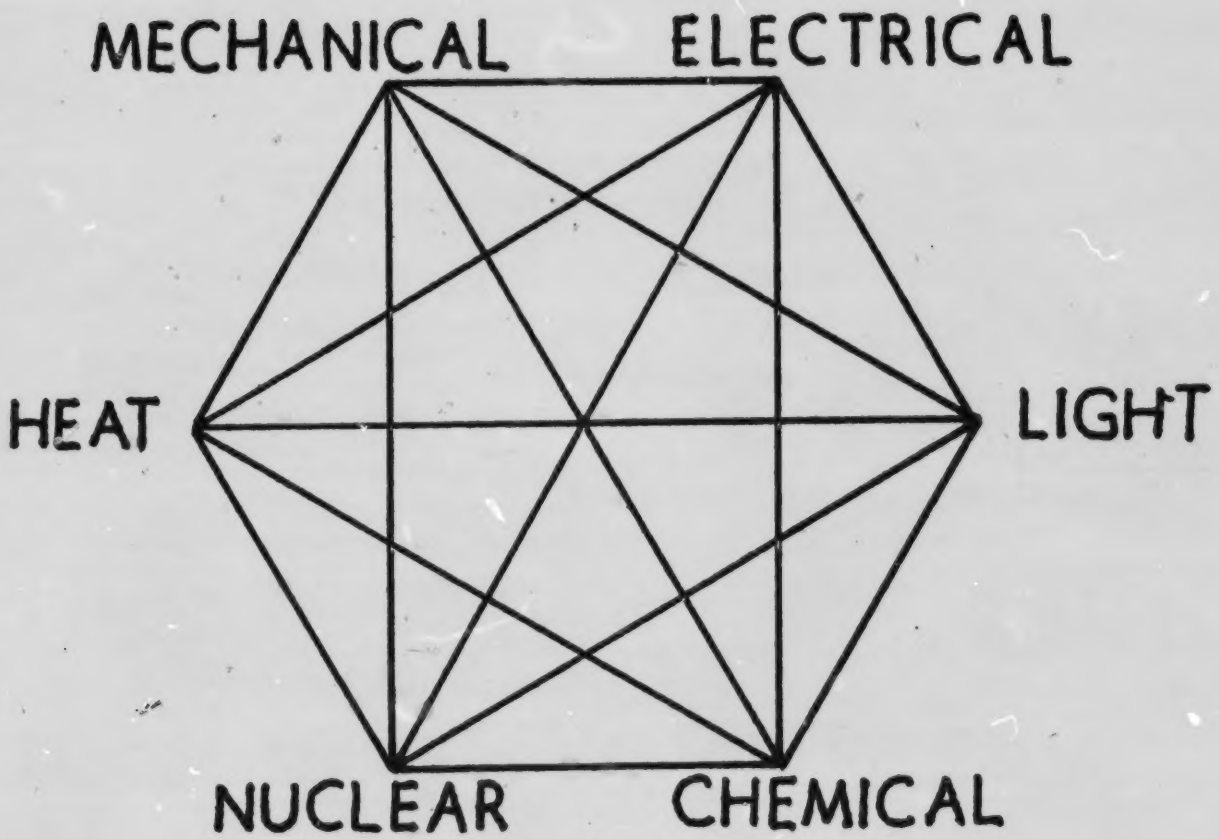
SHAWANO

IECP

PROJECT

CURRICULUM

OUTLINE


MECHANICAL
ELECTRICAL
HEAT
LIGHT
NUCLEAR
CHEMICAL

I. Basic Information
    A. Historical perspective
        1. Past utilization of energy
        2. Present usage and problems
    B. Characteristics of energy
        1. Law of conservation of energy
        2. Types of energy
            a. Potential
            b. Kinetic
    C. Measurement
        1. Exposure to English/Metric
            a. Distance
            b. Mass
        2. Relate measurement to industry
II. Natural sources of energy
    A. Introduction to natural sources
        1. Gravity
            a. How it affects energy
            b. How it is used
        2. Earth heat
            a. Where it comes from
            b. How it is used
        3. Radiant energy
        4. Fossil fuel
        5. Natural fluid power
            a. Wind
            b. Water
            c. Ocean tidal power
                1) Where it comes from
                2) How it is used
    B. Activities in natural sources
        1. Natural fluid power
            a. Wind
                1) How it is harnessed
                2) Where it is used

2. Radiant (Sun)
    a. Direct
        1) How it is harnessed
        2) Where it is used
            a) Natural
            b) Man-made
    b. Indirect
        1) How it is harnessed
        2) Where it is used
3. Fossil fuel
    a. What it is
    b. Where it comes from
    c. Where it is used

III. Forms and measurements
  A. Introduction to the six forms of energy
    1. What they are
    2. How they relate
  B. Activities with forms/measurements
    1. Chemical form
        a. What it is
        b. How it is measured
    2. Electrical form
        a. What it is
        b. How it is measured
            1) Voltage
            2) Current
            3) Resistance
    3. Light form
        a. What it is
        b. How it is measured
            1) Units
            2) Devices
    4. Heat form
        a. What it is
        b. How it is measured
            1) English
            2) Metric

5. Mechanical form
    a. What it is
        1) Work: Power: and Energy
        2) How it is measured
    b. How it is stored
6. Nuclear form
    a. What it is
    b. How it is used in industry
    c. How it is measured

C. How it is used
1. Introduction to applications in industry
2. Activity dealing with energy related occupation

IV. Transmission of energy
A. Introduction to power delivery
1. Overture of all energies
2. Explain power delivery chain

B. Activities for transmission
1. Chemical energy through
    a. Convoy
    b. Pipeline
2. Electrical energy through:
    a. Solids
    b. Liquids
    c. Space
    d. Additional quests in transmission
        1) Storage through capacitor
        2) Storage through inductor
3. Nuclear energy through:
    a. Convoy
    b. Pipeline
4. Light energy through:
    a. Solids
    b. Liquids
    c. Space

5. Mechanical energy through:
    a. Fluids
    b. Clutches
    c. Shafts
    d. Springs
    e. Cams
    f. Belts
    g. Levers
    h. Gears
6. Heat energy through:
    a. Radiation
    b. Conduction
    c. Convection

V. Conversion of energy
  A. Introduction to specific energies conversion
  B. Activities to conversion
    1. Heat energy to:
      a. Mechanical
      b. Electrical
    2. Light energy to:
      a. Heat
      b. Electrical
      c. Mechanical
      d. Chemical
    3. Electrical energy to:
      a. Heat
      b. Light
      c. Mechanical
      d. Chemical
    4. Mechanical energy to:
      a. Heat
      b. Electricity

5. Chemical energy to:
    a. Heat
    b. Light
    c. Electricity
    d. How it is stored
6. Nuclear energy to:
    a. Heat
    b. Electricity

TECHNICAL

SYSTEMS

INC.

CURRICULUM

FLOW

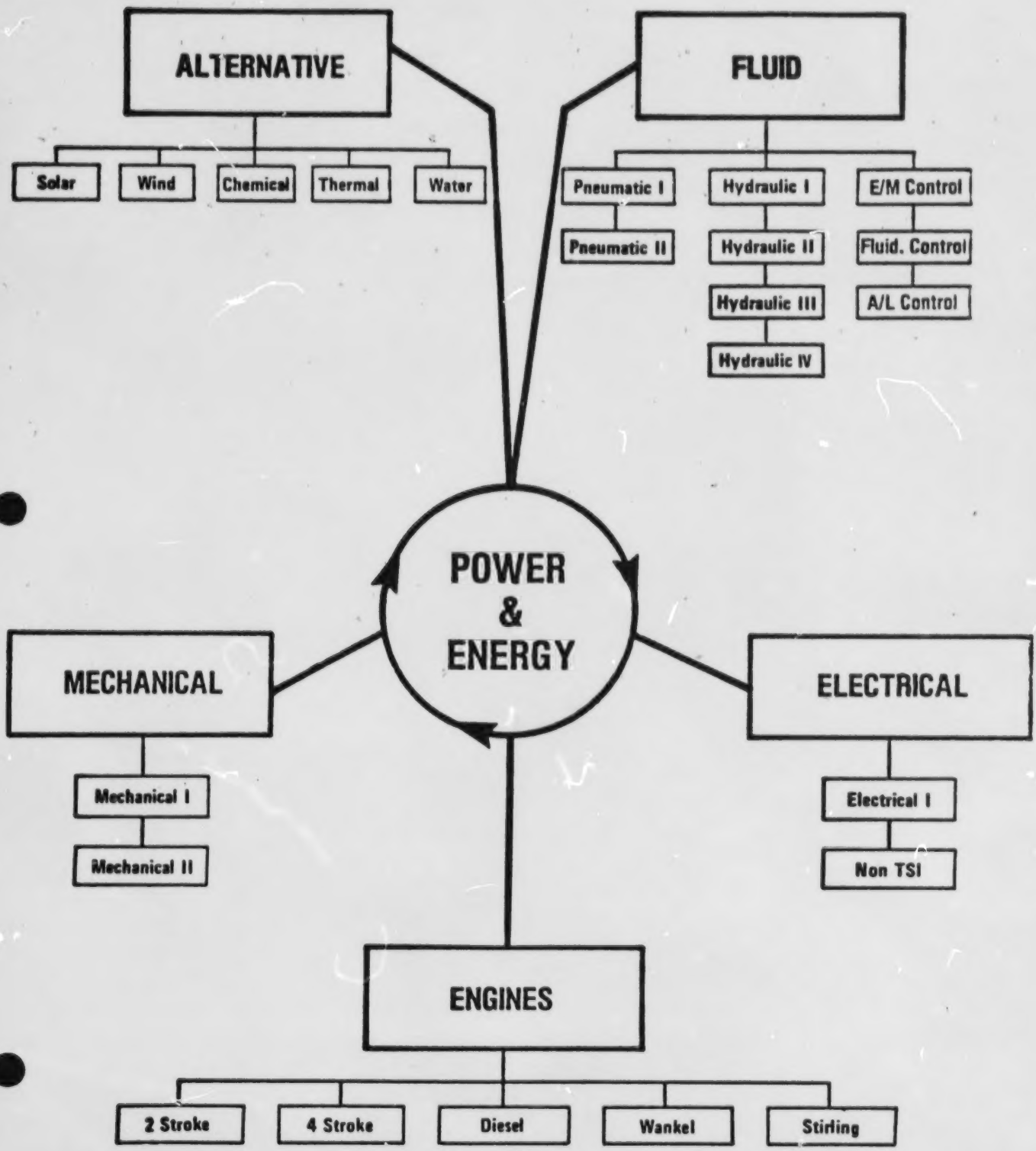
CHART

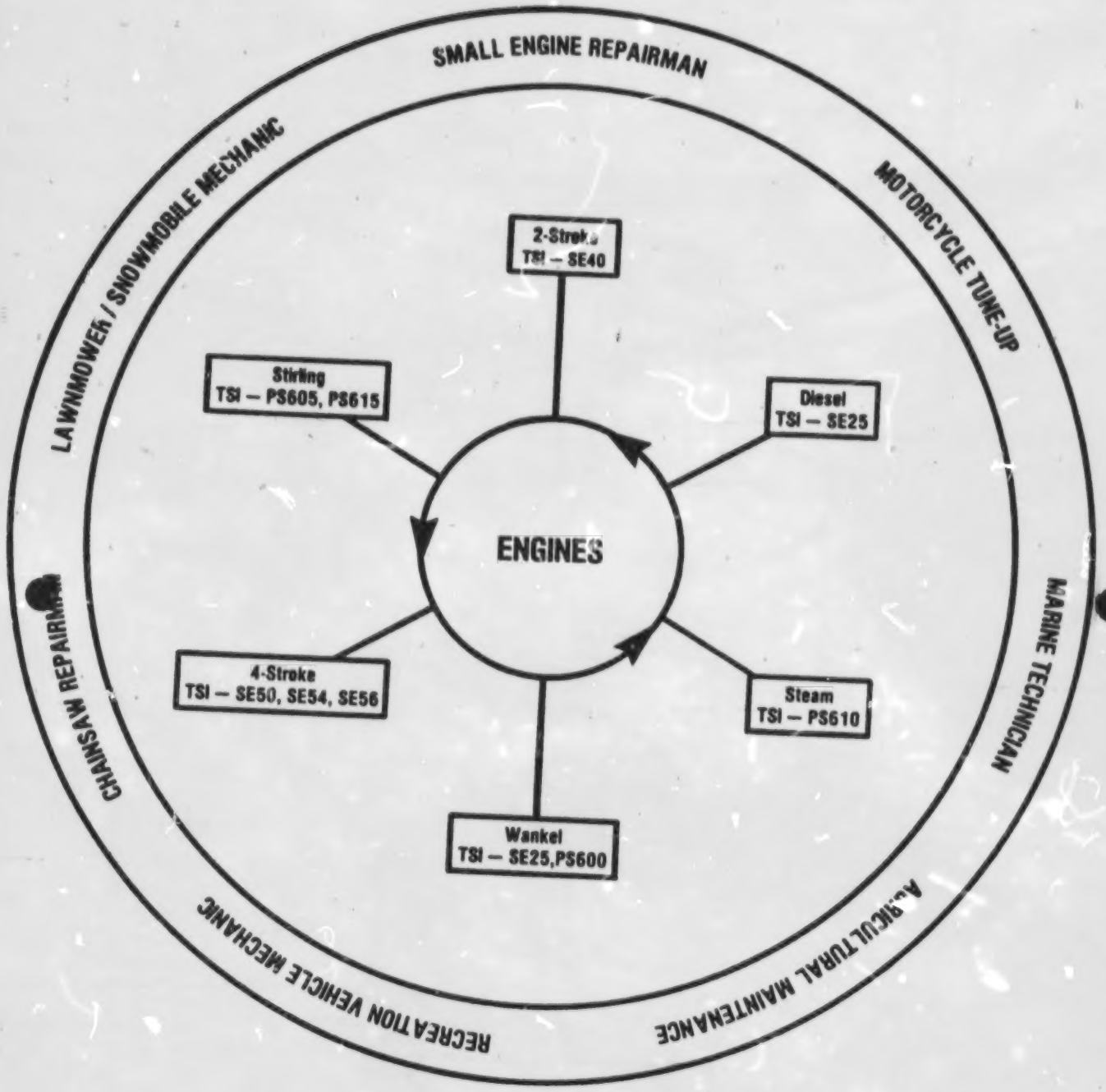
AND

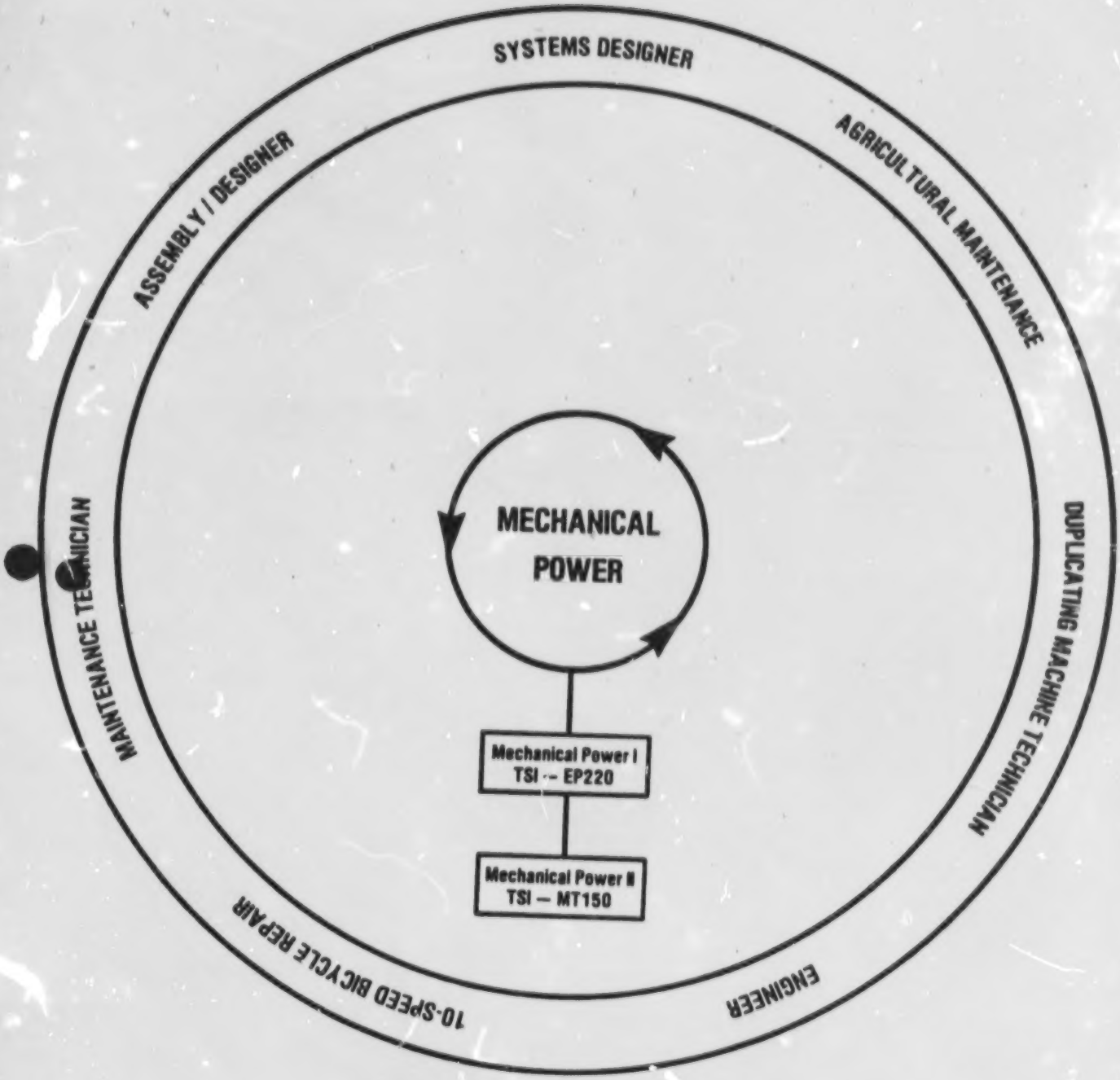
COURSE

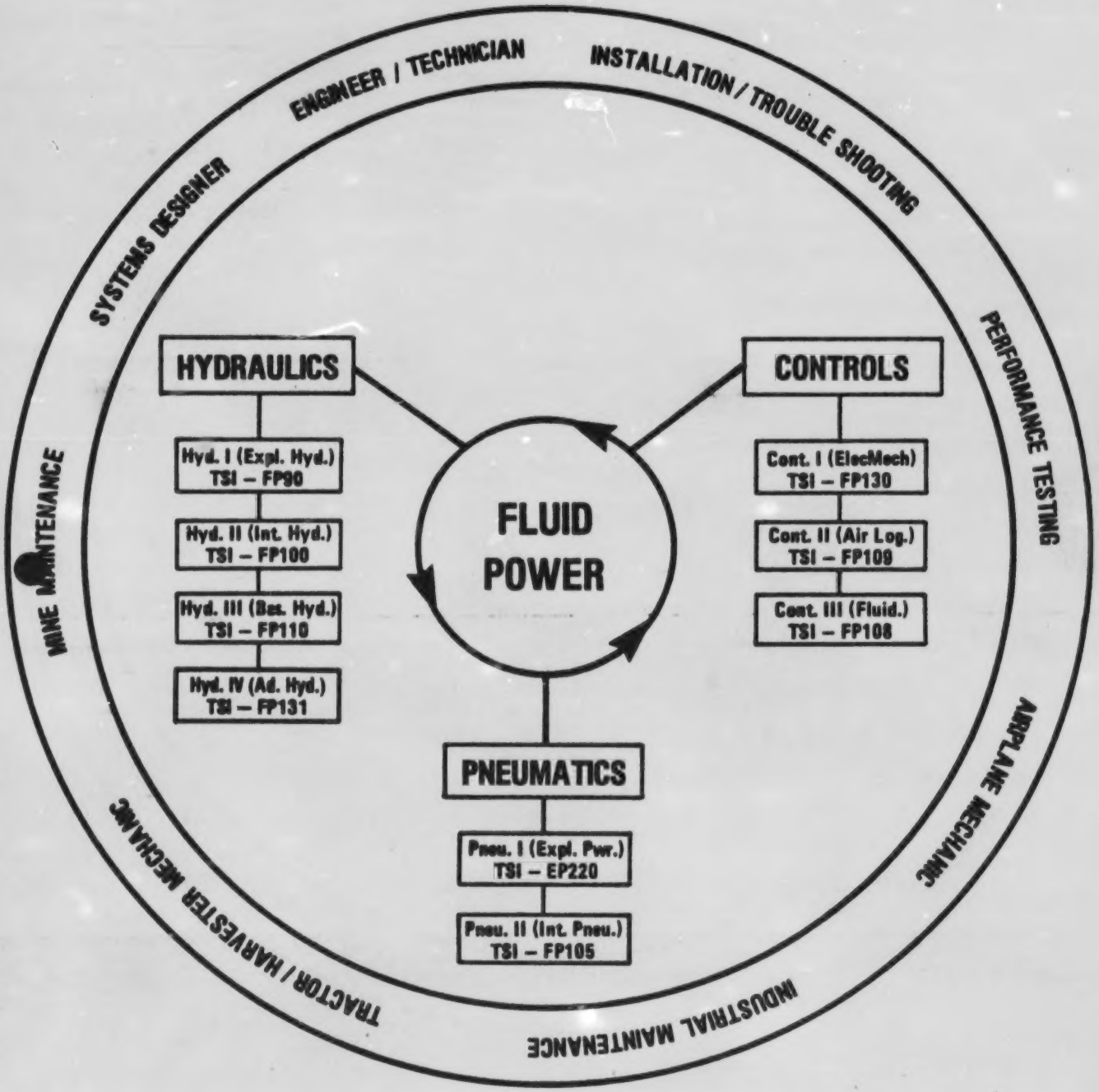
OUTLINES

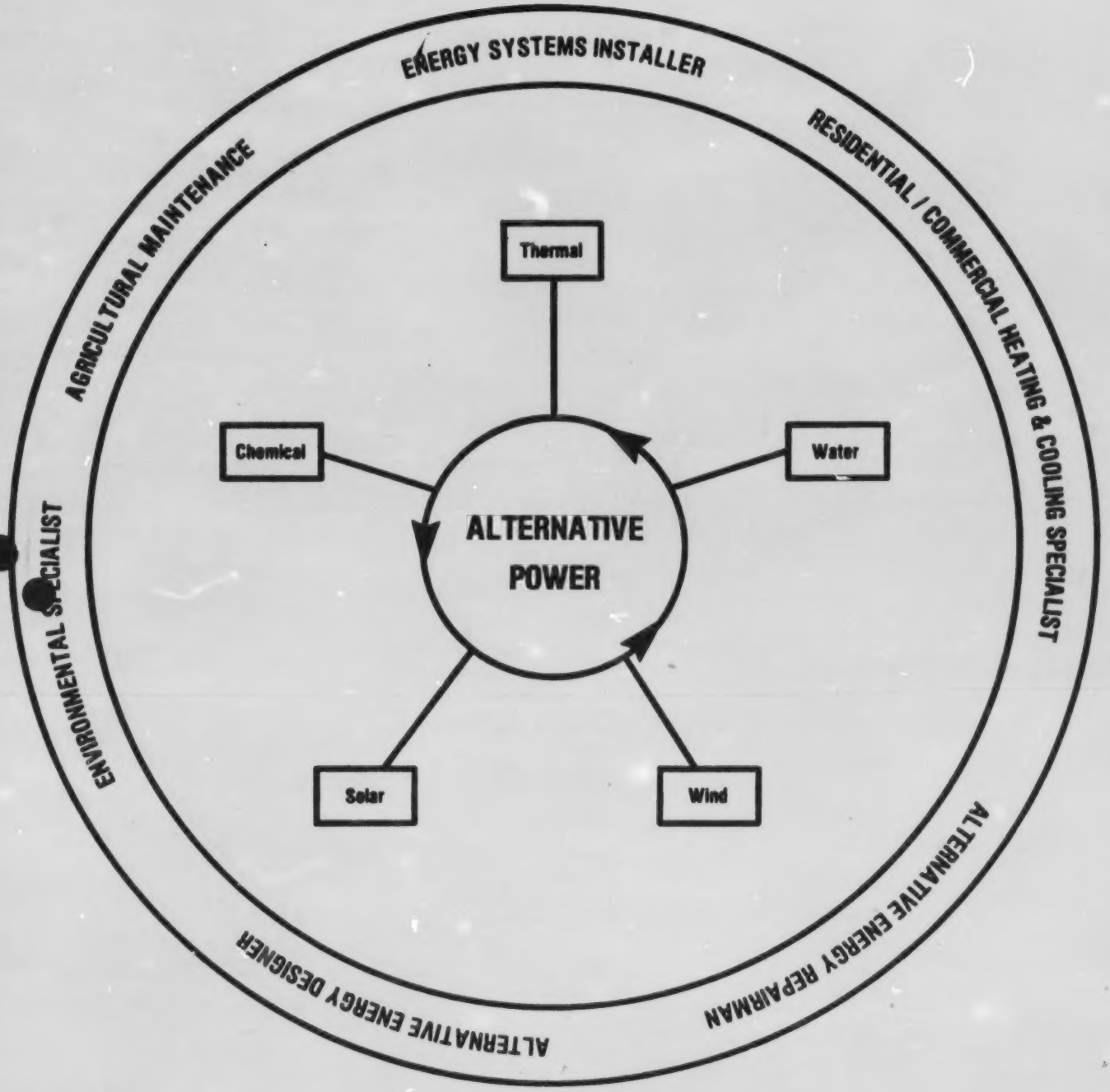
TSI
CURRICULUM FLOW CHART

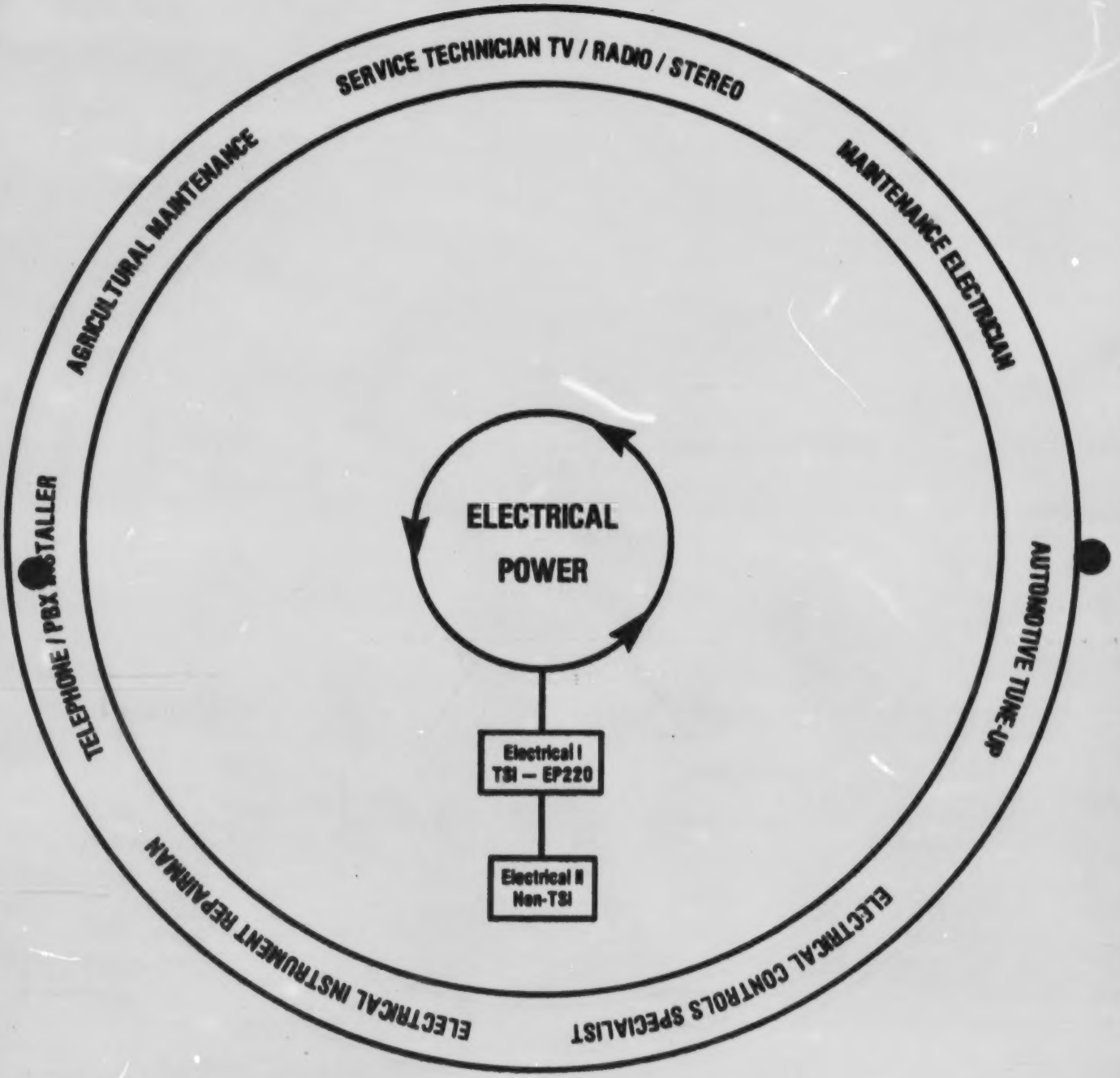



SMALL ENGINE REPAIRMAN
MOTORCYCLE TUNE-UP
MARINE TECHNICIAN
AGRICULTURAL MAINTENANCE
RECREATION VEHICLE MECHANIC
CHAINSAW REPAIRMAN
LAWNMOWER / SNOWMOBILE MECHANIC
2-Stroke
TSI – SE40
Diesel
TSI – SE25
Steam
TSI – PS610
Wankel
TSI – SE25,PS600
4-Stroke
TSI – SE50, SE54, SE56
Stirling
TSI – PS605, PS615
ENGINES


SYSTEMS DESIGNER
AGRICULTURAL MAINTENANCE
DUPLICATING MACHINE TECHNICIAN
ENGINEER
10-SPEED BICYCLE REPAIR
MAINTENANCE TECHNICIAN
ASSEMBLY / DESIGNER
MECHANICAL POWER
Mechanical Power I
TSI -- EP220
Mechanical Power II
TSI — MT150


ENGINEER / TECHNICIAN
INSTALLATION / TROUBLE SHOOTING
PERFORMANCE TESTING
AIRPLANE MECHANIC
INDUSTRIAL MAINTENANCE
TRACTOR / HARVESTER MECHANIC
MINE MAINTENANCE
SYSTEMS DESIGNER
HYDRAULICS
Hyd. I (Expl. Hyd.) TSI – FP90
Hyd. II (Int. Hyd.) TSI – FP100
Hyd. III (Bas. Hyd.) TSI – FP110
Hyd. IV (Ad. Hyd.) TSI – FP131
CONTROLS
Cont. I (ElecMech) TSI – FP130
Cont. II (Air Log.) TSI – FP109
Cont. III (Fluid.) TSI – FP108
FLUID POWER
PNEUMATICS
Pneu. I (Expl. Pwr.) TSI – EP220
Pneu. II (Int. Pneu.) TSI – FP105


ENERGY SYSTEMS INSTALLER
RESIDENTIAL / COMMERCIAL HEATING & COOLING SPECIALIST
ALTERNATIVE ENERGY REPAIRMAN
ALTERNATIVE ENERGY DESIGNER
ENVIRONMENTAL SPECIALIST
AGRICULTURAL MAINTENANCE
Thermal
Chemical
Water
ALTERNATIVE POWER
Solar
Wind


SERVICE TECHNICIAN TV / RADIO / STEREO
MAINTENANCE ELECTRICIAN
AUTOMOTIVE TUNE-UP
ELECTRICAL CONTROLS SPECIALIST
ELECTRICAL INSTRUMENT REPAIRMAN
TELEPHONE / PBX INSTALLER
AGRICULTURAL MAINTENANCE
ELECTRICAL POWER
Electrical I TSI — EP220
Electrical II Non-TSI

TSI Technical School
Technical School, Inc.
2256 Terminal Road
St. Paul, Minnesota 55113
(612) 636 - 6833

Course Title

EXPLORATORY POWER

Course Objectives

1. To explore and experience the technical concepts, hardware, courseware, and recommended learning activities of power and energy systems pertaining to: (a) thermal, (b) solar, (c) wind, (d) water, (e) chemical, (f) steam, and (g) biofuels and fossil fuels.

2. To clarify technical concepts and develop skills relating to: (a) Basic mechanisms, (b) Basic electrical power, (c) Basic hydraulics, and (d) Basic pneumatics.

3. To investigate the technical rationale for selected power systems as used in industrial applications.

Course Components

1. Alternative Energy

2. Mechanisms

3. Electrical

4. Hydraulics

5. Pneumatics

Alternative Energy

I. Thermal
- A. Applications
- B. Temperature
- C. Heat energy and solar radiation
- D. Collectors
- E. Heat transfer
- F. Heat storage
- G. Control systems

II. Solar
- A. Applications
- B. Heating air and water
- C. Radiation and radiant energy
- D. Cooling
- E. Collectors
- F. Storage
- G. Control systems

III. Wind
- A. Applications
- B. Movement of air
- C. Air flow to rotary motion
- D. Air speed measurement
- E. Windmill site location
- F. Windmill features
- G. Wind driven generators
- H. Control systems

IV. Water
- A. Applications
- B. Movement of water
- C. Water flow to rotary motion
- D. Measuring water flow and pressure
- E. Pelton wheel
- F. Water wheel
- G. Turbines
- H. Dams
- I. Power transmission
- J. Control systems

V. Chemical
- A. Applications
- B. Cells
- C. Batteries
- D. Electrodes
- E. Electrolytics
- F. Measurement of electrical potential
- G. Power transmission
- H. Control systems

VI. Steam
- A. Applications
- B. Heat energy and thermodynamics
- C. Early development of steam power
- D. Steam engines
- E. Reciprocating and rotary motion
- F. Steam and transportation
- G. Steam and heat systems
- H. Steam and electrical power generation
- I. Turbines
- J. Power transmission
- K. Control systems

VI. Biofuels and Fossil Fuels
- A. Applications
- B. Biomass
- C. Solar efficiency of biomass production
- D. Biomass conversion
- E. Coal
- F. Oil
- G. Gas

Electrical

I. Introduction
   A. Heat applications
   B. Light applications
   C. Motion applications

II. Electron Theory
   A. Atom
   B. Electron
   C. Proton
   D. Neutron
   E. Like and unlike charges
   F. Magnetism

III. Electrical Measurement
   A. Ampere
   B. Volt
   C. Ohm
   D. Watt

IV. Current
   A. Alternating
   B. Direct
   C. Flow in circuits
   D. Cycle

V. Power Input
   A. Cells, batteries, and energizers
   B. Generators

VI. Control and Transmission
   A. Circuits
   B. On/off control devices
   C. Directional control devices for current flow
   D. Overload control devices
   E. Quantity control devices for current flow
   F. Transmission

VII. Power Output
   A. Conversion to motion
   B. Conversion to heat and light
   C. Use in communication
   D. Common electrical circuits

Mechanisms

I. Mechanical Conversion and Control Systems
   - A. Natural
   - B. Man-made

II. Measurement of Force, Inertia, Torque, Acceleration, and Work
   - A. Friction and inertia
   - B. Vectors
   - C. Equilibrium
   - D. Torque
   - E. Acceleration
   - F. Horsepower

III. Simple Machines
   - A. Levers
   - B. Wheel and axle (Pulleys)
   - C. Inclined plane
   - D. Screw

IV. Transmission of Force Through Mechanical Connectors
   - A. Six gear train
   - B. Five gear train
   - C. Compound gear train
   - D. Rack and pinion
   - E. Right angle drive, gear
   - F. Simple belt drive
   - G. Crossed belt drive
   - H. Complex "O" ring drive
   - I. Right angle drive, belt
   - J. Simple cog belt drive
   - K. Complex cog belt drive

V. Mechanical Controls
   - A. Clutches
   - B. Brakes

VI. On-way Motion Controls

VII. Reciprocating to Rotary Converters
   - A. Rod
   - B. Crank

VIII. Rotary Oscillators or Non-uniform Velocity Mechanisms

IX. Mis-alignment Correcting Devices

X. Variable Speed Drive

XI. Interface Connectors

XII. Differential Motion Machines

XIII. The Bicycle as an Energy Converter

Hydraulics

I. Hydraulic Systems, Natural and Man-made

II. Measurement of pressure

III. Transmission of force through liquids and gases

IV. Conversion of force to pressure

V. An aircraft landing gear

VI. Hydraulic pumps, reservoirs, and filters

VII. Control wtih two-way valves

VIII. Control with three-way valves

IX. Control with four-way valves

X. Check valves and relief valves

XI. Fluid flow and transmission

XII. Fluid actuators

XIII. Fluid power symbols

XIV. Shock absorbers and dampers

Pneumatics

I. Fundamentals of pneumatics

II. Graphic communication and parts identification

III. Characteristics and behavior of compressed air

IV. Compression of air

V. Transmission and distribution of compressed air

VI. Compressed air line filters

VII. Controlling and measuring air pressure

VIII. Fixed pressure and flow control

IX. Fundamentals of linear actuators

X. Double-acting pneumatic linear actuators

XI. Force, pressure, and area relationships

XII. Cylinder speed control

XIII. Air control devices

XIV. Sequencing pneumatic cylinders

XV. Air rotary actuators

XVI. Fundamentals of linear air bearings

XVII. The Venturi Tube

Course Title

POWER AND ENERGY INSTRUCTIONAL MATERIALS DEVELOPMENT

Course Objectives

1. To synthesize learning style concepts, analyze procedures for the identification of learning styles, and establish criteria for differentiating learning style features of designated learners.

2. To establish desired outcomes for designated learners within the following domains: (a) cognitive, (b) psycho-motor, and (c) affective.

3. To analyze and compare the design options and preparation procedures for a designated group of learners.

4. To function as a developer and one who critiques resource materials for a designated group of learners.

5. To produce learning resource materials for a designated group of learners.

6. To structure "model" utilization plans for prepared learning resource materials for a designated group of learners.

Course Outline

I. Learning style analysis
   - A. Maturation level
   - B. Eduation achievement level
   - C. Interest, readiness, and self-motivation level
   - D. Resource materials literacy and acceptance level
   - E. Learning difficulties and constraints
   - F. Gifted learning talents
   - G. Learning method options
   - H. Learning resource material options
   - I. Learning activity options
   - J. Pacing learning activities

II. Learning objective analysis
   - A. Cognitive
   - B. Psycho-motor
   - C. Affective

III. Resource Material Design
   - A. Major and minor objectives
   - B. Concept analysis
   - C. Content analysis
   - D. Print/nonprint analysis and options
   - E. Format guidelines
   - F. Format options

IV. Resource material development
   A. Planning
   B. Writing
   C. Illustrating
   D. Sequencing
   E. Group reviewing, reacting, and assessing
   F. Recommendations for revision
   G. Recommendations for production

V. Resource materials production
   A. Planning for print/nonprint preparation and production
   B. Implementation of production activities
   C. Evaluation of prepared resource materials

VI. Classroom utilization plans
   A. Learner readiness
   B. Learner activities
   C. Learner reaction
   D. Learner assessment
   E. Teacher assessment

TSI Technical School
Technical Systems, Inc.
2256 Terminal Road
St. Paul, Minnesota 55113
(612) 636 - 6833

Course Title

FLUID POWER

Course Objectives

1. To become oriented to the technical concepts inherent in fluid power systems and to identify systems component hardware.
2. To describe the circuits of fluid power systems through the language of symbols.
3. To analyze the operational function and design of component hardware.
4. To analyze the features of special purpose circuits.
5. To compare the components and circuitry of hydraulic and pneumatic systems.
6. To clarify the operating function and design of electro-mechanical control used in fluid power systems.
7. To investigate the rationale for the design of specific fluid power applications.

Course Outline

I. Hydraulics
   - A. Fundamental hydraulic circuit
   - B. Basic physical laws
   - C. Pressure and force
   - D. Flow rate and velocity
   - E. Work, power, and horsepower
   - F. Properties of hydraulic fluids
   - G. Fluid power symbols
   - H. Hydraulic pumps
   - I. Fluid storage and conditioning
   - J. Fluid transmission
   - K. Introduction to control valves
   - L. Pressure control valves
   - M. Directional control valves
   - N. Flow control valves
   - O. Linear actuators
   - P. Rotary actuators
   - Q. Basic flow control circuits
   - R. Directional valve leakage and control

II. Pneumatics
- A. Fundamentals of pneumatics
- B. Graphic communication
- C. Characteristics and behavior of compressed air
- D. Compression of air
- E. Transmission and distribution of compressed air
- F. Compressed air line filters
- G. Controlling and measuring air pressure
- H. Fixed pressure and flow control
- I. Fundamentals of linear actuators
- J. Double-acting pneumatic linear actuators
- K. Force, pressure, and area relationships
- L. Cylinder speed control
- M. Air control devices
- N. Sequencing pneumatic cylinders
- O. Air rotary actuators
- P. Fundamentals of linear air bearings
- Q. Pressure-flow relationship
- R Velocity-pressure relationship

III. Electro-mechanical control of fluid power
- A. Basic electricity for fluid power control
- B. Solenoids and relays
- C. Directional control valves: two position, solenoid operated
- D. Directional control valves: three position, solenoid operated
- E. Electrical symbols and schematic diagrams
- F. Electrical switches
- G. Relay circuits
- H. Reciprocation of air cylinders
- I. Reciprocation of hydraulic cylinders and pump unloading
- J. Sequencing of cylinders
- K. Special circuits

TSI Technical School.
Technical Systems, inc.
2256 Terminal Road
St. Paul, Minnesota 55113
(612) 636 - 6833

Course Title

SMALL ENGINE CONCEPTS, COMPONENTS, AND TESTING

Course Objectives

1. To identify the developmental stages and progress of controlled heat and motion within external and internal combustion engines.

2. To clarify the scientific concepts of converting heat energy into mechanical energy.

3. To analyze and compare current heat engines: their operating functions, construction designs, component parts, and operating efficiencies.

4. To analyze the functional designs of stationary and moving parts within the systems of selected small piston engines such as: fuel, electrical, lubrication, cooling, bearing, timing, and power transmission.

5. To use measurement tools and procedures for gathering engine operation data.

6. To perform general care and adjustment tasks with small piston engines pertaining to: tune-up, testing, troubleshooting, and maintenance.

Course Modules

Module One: I. Engine Development
II. Small Piston Engines
III. Measurement Tools and Procedures

Module Two: IV. Four Stroke Cycle(Gasoline)

Module Three: V. Two Stroke Cycle (Gasoline)

Module Four: VI. Diesel Engine

Module Five:VII. Dynomemeter

Course Module Outlines

Module One:

I. Engine Development
   A. History
      1. Engine Developers
      2. Initial Engine Features
   B. Current Heat Engines
      1. External Combustion
      2. Internal Combustion
      3. Piston 4-Stroke Cycle
      4. Piston 2-Stroke Cycle
      5. Gasoline and Diesel
      6. Rotary
      7. Others

II. Small Piston Engines
   A. Stationary and Moving Parts
      1. Block Designs
      2. Head Designs
      3. Piston Assembly
      4. Connecting Rod Assembly
      5. Crankshaft Assembly
      6. Camshaft Assembly
      7. Valve Assembly
   B. Four Stroke Cycle
      1. Intake
      2. Compression
      3. Ignition and Power
      4. Exhaust
   C. Two Stroke Cycle
      1. Intake
      2. Compression
      3. Ignition and Power
      4. Exhaust
   D. Fuel System
      1. Fuel Distillation Process
      2. Engine Fuel Storage Tank
      3. Carburetion
      4. Air Cleaner
      5. Fuel Line Filter
      6. Pump
      7. Throttle and Governor
      8. Choke
   E. Electrical System
      1. Battery
      2. Starter
      3. Ignition

F. Lubrication System
   1. Oil and Viscosity
   2. Splash
   3. Pump
   4. Slinger
   5. Filter
G. Cooling System
   1. Operating Temperatures
   2. Air Cooling Systems
   3. Liquid Cooling Systems
   4. Water Pump
   5. Thermostat
H. Bearing System
   1. Roller
   2. Ball
   3. Rod and Main
I. Timing System
   1. Mechanical
   2. Electrical
J. Small Engine Power Transmission
   1. Direct Drive
   2. Gear Drive
   3. Belt Drive
   4. Chain Drive

III. Measurement Tools and Procedures
   A. Piston Stroke
   B. Cylinder Bore
   C. Displacement
   D. Compression Ratio
   E. Shaft Geometry
   F. Electrical Gaps
   G. Gear Ratio
   H. Air/Fuel Ratio
   I. Horsepower
   J. Operation Speed
   K. Valve Lift, Seat Angle, and Timing
   L. Screw Threads
   M. End Play
   N. Bearing Clearance

Module Two

IV. Four Stroke Cycle (Gasoline)
  A. Four Stroke Cycle Engine Applications
    1. Automotive
    2. Truck/Tractor
    3. Farm Vehicles
    4. Marine and Recreational
    5. Aircraft
    6. Construction
    7. Industrial
    8. Residential
    9. Others
  B. Theory (One Cylinder Engines)
    1. Engine Components and Systems
    2. Engine Cycle
    3. Fuel System
    4. Starter System
    5. Electrical System
    6. Lubrication System
    7. Cooling System
    8. Bearing System
    9. Timing System
    10. Power Transmission
  C. Disassembly
    1. Disassembly Plan of Approach
    2. Tools
    3. Procedures and Techniques
  D. Reassembly
    1. Reassembly Plan of Approach
    2. Tools
    3. Procedures and Techniques
  E. General Care and Adjustment
    1. Tune-up
    2. Testing
    3. Troubleshooting
    4. Maintenance

Module Three

V. Two Stroke Cycle (Gasoline)
  A. Two Stroke Cycle Applications
    1. Automotive
    2. Residential
    3. Recreational
    4. Others
  B. Theory (One Cylinder Engines)
    1. Engine Components and Systems
    2. Engine Cycle
    3. Fuel System
    4. Starter System
    5. Electrical System
    6. Lubrication System
    7. Cooling System
    8. Bearing System
    9. Timing System
    10. Power Transmission
  C. Disassembly
    1. Disassembly Plan of Approach
    2. Tools
    3. Procedures and Techniques
  D. Reassembly
    1. Reassembly Plan of Approach
    2. Tools
    3. Procedures
  E. General Care and Adjustment
    1. Tune-up
    2. Testing
    3. Troubleshooting
    4. Maintenance

Module Four

VI. Diesel Engine
- A. Diesel Engine Applications
  1. Automotive
  2. Truck/Tractor
  3. Farm Vehicles
  4. Marine
  5. Electric Power Generator Drivers
  6. Construction
  7. Industrial
  8. Others
- B. Theory
  1. Engine Components and Systems
  2. Engine Cycle
  3. Fuel System
  4. Starter System
  5. Lubrication System
  6. Cooling System
  7. Bearing System
  8. Timing System
  9. Power Transmission
- C. Disassembly
  1. Disassembly Plan of Approach
  2. Tools
  3. Procedures and Techniques
- D. Reassembly
  1. Reassembly Plan of Approach
  2. Tools
  3. Procedures and Techniques
- E. General Care and Adjustment
  1. Tune-up
  2. Testing
  3. Troubleshooting
  4. Maintenance

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Module Five

VII. Dynomometer
- A. Power Measurement
  1. Indicated Horsepower
  2. Friction Horsepower
  3. Rated Horsepower
  4. Power Conversions
- B. Safety
  1. Attitude
  2. Clothing
  3. Cleanliness
  4. Safety with Tools
  5. High Temperatures
  6. High Voltages
  7. High Speed Rotating Parts
  8. Exhaust
  9. Explosive and Flamable Materials
  10. Sound Levels
  11. Back Firing
- C. Instrumentation
  1. Calibrating the Force Gauge
  2. Calibrating the Tachometer
- D. Mounting Engines
  1. Vertical Shaft Engines
  2. Horizontal Shaft Engines
  3. Flywheel Coupler Assembly
- E. Operating Instructions
  1. Friction and Compression
  2. Flywheel Action
  3. R.P.M. and Torque
  4. Horsepower with Fixed Throttle
  5. Governor Action
  6. Carburetion System
  7. Exhaust System
  8. Engine Vibration

LEARNING ACTIVITIES:

The ultimate success of any program centers in the quality of the instruction that takes place. Central to this success is the quality of the teaching and learning activities that are used in meeting stated objectives.

Industrial education programs have always focused on the laboratory appraoch of "learning by doing" The ideas for teachers and the learning activities for students that are included in this handbook were selected as exemplary learning experiences.

Industrial education programs should be exciting, relevant and action oriented. Well designed activities, selected from a variety of sources, that motivate students are included as suggestions for improving instruction.

ENERGY

ACTIVITY

GUIDE

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COMMENT

Man stands at the end of a long cycle of energy exchanges in which there is a calculable and irreversible loss of energy at each exchange. A grown adult irradiates heat equivalent to that of a 75-watt bulb. His total energy output, in 12 hours of hard physical work, is equivalent to only 1-kilowatt hour. He requires daily 2200 calories of food intake, 4 1/2 pounds of water and 30 pounds of air, and he discards five pounds of waste. Considered as an energy converter, man is the least efficient link in his particular "food chain," and for this reason the most vulnerable to catastrophic ecologic change. Such a change can be caused by overloading the energy circuit. There are two new humans added to the globe's population every second.

Don Fabun, Dimensions of Change

The standard of living of a given country is related directly to its per capita gross national product and its per capita energy consumption. Data suggests that if a lesser developed country desires the standard of living of a developed country it must aspire to more energy-intensive activities. In a very real way energy and money are equivalent. To what degree the terms "standard-of-living" and "quality of life" are synonymous has been debated at length. However, it seems clear that future debates will take on increasingly practical dimensions.

It has been argued that the high standard of living of the U.S. is predicated on our history of collective scientific and technical ingenuity. But it can also be pointed out that the rapid industrial growth of the U.S. was made possible, in large part, by the discovery and exploitation of large reserves of high grade iron ore and coal in close proximity to one another, and the nearness of these resources to avenues of water transportation -- that is to say, fortunate geological coincidences. Coal provided energy to process the iron into the machines that gave us incredible mobility. Coal was abundant and cheap, as was oil. Oil fueled and lubricated our railroads, trucks and automobiles. Energy was so cheap we squandered it without much thought to its non-renewable nature. We have forgotten that non-renewable resources eventually become physically or economically impractical and must be replaced by a new resource. Characteristically, the high grade resources are used first because they are more available and cheaper to process; thus leaving the more inaccessible and more expensive resources for later exploitation. Obviously it requires increasingly larger quantities of energy to process lower grade ores. Because the traditional forms of energy are non-renewable resources the problem is compounded. Considered with population growth and the dramatic increase of resource consumption characteristic

of the 1950's, 60's and early 70's, the demands on non-renewable resources become untenable. The world is not in danger of being depleted of resources in the immediate future; more accurately, the question centers on our ability to cope with the pressures of change and redistribution.

In the mid 1970's we entered a period of hydrocarbon scarcity which began to dampen economic growth in the industrialized nations. This coming of hydrocarbon scarcity is in part a result of the oil producing nation's desire for a fair share of the benefits of their resources. We in the technologically advanced and energy intensive nations must begin to make trade-offs that will markedly influence the future world society. It is unlikely that we can continue to use huge quantities of natural resources without an understanding of both the short and long-range economic, geopolitical and environmental consequences of our actions. It has been said, *"To err is human but when the eraser wears out before the pencil we're overdoing it."*

We must learn how everything we do both individually and collectively is related to energy. We must come to consider every resource as a valuable asset to be expended wisely. Educators have a principal role in achieving this critical task. Perhaps the message was most clearly stated by the wise person who observed:

Everything must *come from somewhere* (there is no such thing as a free lunch).

Everything must *go somewhere* (there is no "away").

Everything is connected to everything else.

USES OF ENERGY

GOAL: It is essential that each person know that people are dependent upon energy.

CONCEPT: I. All living things and natural processes require energy.

OBJECTIVE:

A. The student will simulate a food chain or food web.

B. The student will know that energy is necessary for growth.

C. The student will understand that all non-living natural processes require the input of energy.

D. The student will understand how and why living things store energy.

E. The student will understand how different organisms get their energy.

CONCEPT: II. Each form of energy can be used in many ways.

OBJECTIVE:

A. The student will understand that fossil fuels and other natural resources have both energy and non-energy applications.

B. The student will understand ways in which different energy sources may be used.

C. The student will understand that some energy resources and applications may be used in ways that are more aesthetically pleasing than others.

D. The student will know how energy is used at home, at school, and in the broader community.

E. The student will understand how engines use energy.

F. The student will understand that energy use follows a path from source to ultimate destination.

CONCEPT: III. All industrial processes make use of several forms of energy.

OBJECTIVE:

A. The student will understand that some forms of energy are more efficient and more applicable to certain uses than are others.

CONCEPT: IV. Some human technologies and activities use more energy than others.

OBJECTIVE:

A. The student will understand that different amounts of energy are used in the production of everyday items in the environment.

B. The student will understand why some technologies use more energy than do others.

C. The student will understand that availability of ample energy resources has produced high energy use technologies.

D. The student will learn that decisions to allocate future energy resources and to build future technologies may be based upon economic, aesthetic, political and social judgments.

E. The student will know and work with the basic units of energy measure.

F. The student will understand how man has used energy throughout history.

CONCEPT: V. Every decision made involving energy affects standards of living.

OBJECTIVE:

A. The student will understand the concept of a high standard of living.

B. The student will understand the relationship between standard of living and energy use.

C. The student will know which of the world's countries fall into the have and have nots and how/why the categorizations have changed over time.

D. The student will know the advantages which the people of a high standard of living country have over the people of a low standard of living country and the role that energy plays in contributing to the inequality.

E. The student will know energy choices man might make which would have trade-offs involved and be able to defend the choice on the basis of the trade-off created.

F. The student will know how social pressures to have things and use energy are created.

G. The student will know that planned obsolescence exists and is not in the best interest of society.

H. The student will know the concept of affluence and understand that its definition is peculiar to a given culture at a given time.

I. The student will know the various percentages of total energy use that each energy source provides and how those percentages have changed over time.

CONCEPT: VI. Social, economic and political pressures influence the efficient and economical use of energy.

OBJECTIVE:

A. The student will understand that governments establish regulatory controls which are designed to control energy use and pollution.

B. The student will realize that individuals may band together in citizen groups to effect political/social/economic choice.

C. The student will understand economic, political and social pressures which have been used to encourage the efficient and economical use of energy.

D. The student will understand that various governments have passed legislation which has affected the development and conservation of energy resources.

E. The student will understand that power balance shifts among countries often hinge on energy issues and concerns.

CONCEPT: VII. There are many ways to conserve energy.

OBJECTIVE:

A. The student will know numerous ways by which energy may be conserved at home, at school, and in the broader community.

B. The student will understand that some energy conservation practices may be more economical than others.

C. The student will know alternate strategies which may be employed by industry to conserve energy.

D. The student will note that industries and governments develop alternative strategies through a process of research and development.

SOURCES OF ENERGY

GOAL: **It is essential that each person know that there are many sources of energy.**

CONCEPT: I. Energy is the capacity to do work and is subject to natural laws.

OBJECTIVE:

A. The student will understand that energy is the capacity to do work and is subject to natural laws.

B. The student will be able to explain the meaning of "work."

C. The student will recognize that energy units measure the ability to do work.

D. The student will be familiar with the difference between kinetic and potential energy.

CONCEPT: II. Most specific forms of energy originated with the sun.

OBJECTIVE:

A. The student will understand the physical arrangement of the solar system.

B. The student should be familiar with the laws of gravitational attraction that keep the planets orbiting the sun and moves the tides on earth.

C. The student will understand that the sun's radiation produces surface and atmospheric heat.

D. The student will explain how the sun contributes to earth's life forms.

E. The student will understand that adoration of the sun's energy has contributed to the development of the religions of the world.

F. The student will know that the sun's energy can be stored for later use.

G. The student will understand that the sun can be used directly by humans.

CONCEPT: III. Natural processes are constantly forming and concentrating fossil fuels, but at a rate much slower than these sources are being used.

OBJECTIVE:

A. The student will understand the biological, chemical and geologic method of formation of each fossil fuel - coal, oil, gas and peat.

B. The student will understand the slow rate of formation of fossil fuels and the rate at which these fuels are being used today.

C. The student will understand the geologic origin of non-fossil fuel energy sources in the earth such as radioactive minerals.

CONCEPT: IV. Energy resources are unevenly distributed around the earth.

OBJECTIVE:

A. The student will understand why there is high heat flow in some areas but not in others, thereby affecting geothermal energy potential.

B. The student will understand that some geographic locations of wind, riverine, tidal and solar electric power plants are better than other locations.

C. The student will know the current locations of present and possible future fossil fuels.

D. The student will understand that nations with abundant resources have advantages over those who must purchase their energy resources from others.

CONCEPT: V. High grade (concentrated) energy sources occur in relatively small amounts, and take relatively smaller amounts of "outside" energy to find and recover.

OBJECTIVE:

A. The student will understand the concept of high grade for each form of energy.

B. The student will know energy costs for production of various fuels.

C. The student will know the approximate quantities of high, medium and low grade resources that are available to man.

D. The student will understand the difference between exploration (finding) and exploitation (producing).

E. The student will know that new technologies will be used to mine or recover energy sources.

CONCEPT: VI. Access to energy sources affects the growth of differing technological, social, governmental, economic and cultural systems.

OBJECTIVE:

A. The student will know the dominate energy sources for various cultures, past and present.

B. The student will know the flow of energy sources between countries in modern times and how it is likely to change.

C. The student will know that the location of cities and industrie is often primarily influenced by access to energy sources.

D. The student will be aware of the influence of changing access to energy sources on the patterns of cultural development.

CONCEPT: VII. Exploitation of different energy sources results in a variety of occupations.

OBJECTIVE:

A. The student will explore the variety of occupations available in energy related industries.

CONVERSION OF ENERGY

GOAL: **It is essential that each person know that energy can be converted from one form to another.**

CONCEPT: I. There are natural and man-made energy conversion systems subject to natural laws.

OBJECTIVE:

A. The student will be able to identify the relationship between the first and second laws of thermodynamics and conversions.

B. The student will be able to define a "natural energy conversion system."

C. The student will be able to define man-made conversion systems.

D. The student will compare the efficiency of natural and man-made energy conversion systems.

E. The student will identify several man-made types of energy conversion.

F. The student will support the statement that "The waste products from a man-made energy conversion system are more difficult for the natural environment to accommodate than waste from natural energy conversion systems."

CONCEPT: II. All conversion processes use energy or lose heat energy.

OBJECTIVE:

A. The student will describe the transfer of energy in living systems.

B. The student will be aware that no conversion process is completely efficient. The price of conversion from a less usable to a more usable form is always waste heat. (e.g., chemical energy in oil to mechanical energy in an engine).

C. The student will be able to list the ways energy is used to exploit various energy sources.

D. The student should be able to identify by-products resulting from energy conversion.

CONCEPT: III. "Direct" energy use is more efficient than converted energy use but converted energy is more versatile.

OBJECTIVE:

A. The student will be able to describe the earth's heat budget.

B. The student will be able to determine the major factors which limit amount of solar energy reaching and being reflected from the earth.

C. The student will be able to identify examples of "direct energy" uses.

D. The student will be able to describe examples of indirect energy conversion situations that work for man.

CONCEPT: IV. There is a variety of units of measure for the efficiency of energy conversion.

OBJECTIVE:

A. The student will compare the energy output of a conversion system to the energy content of the energy source and note the unit of measure for each.

B. The student will identify at least seven units of measure to be used in comparing energy sources and the results of conversion.

CONCEPT: V. Energy "costs" are partly related to the efficiency of energy conversions and transport.

OBJECTIVE:

A. The student will explain why electricity costs less to produce from some sources than from others.

B. The student will compare published efficiencies of conversion costs of conventional nuclear and fossil steam electric plants with those of a proposed magnetohydrodynamics system.

C. The student will be able to evaluate the costs related to the efficiency of different energy conversions.

D. The student will be able to compare the conversion costs of energy forms to their competitive economic relationship.

E. The student will identify reasons why energy costs more at the point of delivery to the customer than it did at the point of origin.

CONCEPT: VI. There are ethical, legal, aesthetic, social, political, economic, biological and physical benefits and problems associated with energy conversion.

OBJECTIVE:

A. The student will describe the legal, physical and aesthetic problems resulting from the construction of energy conversion plants.

B. The student will describe the physical reasons for the conversion of energy.

C. The student will identify some of the biological problems arising from the conversion of energy.

D. The student will identify ways that energy conversions by utilities benefit a community.

E. The student will be aware that there are problems arising from the disposal of energy conversion wastes.

CONCEPT: VII. Energy conversion technology has created technological and industrial changes.

OBJECTIVE:

A. The student will identify several pre-industrial societies which made little or limited use of energy conversions.

B. The student will be able to relate energy conversion technologies to standard of living.

C. The student will be able to describe how transportation has been affected by energy conversion.

D. The student will be able to identify the ways an industrial society makes use of energy conversion.

E. The student will be able to relate technological advances in energy conversion with society's industrialization.

CONCEPT: VIII. History can be described in terms of the level of energy conversion technology.

OBJECTIVE:

A. The student will be able to describe the major types of energy conversion used by early man.

B. The student will identify civilizations which used only conversions related to wind, fire, falling water and muscle power.

C. The student should be aware of the use of the energy source, coal, that led to the industrial revolution.

D. The student will explain the chronological patterns evident in the discovery and utilization of fuel conversion processes.

CONCEPT: IX. Employment opportunities are created or destroyed in the evolution of conversion technologies.

OBJECTIVE:

A. The student will be able to compare the jobs created and the jobs replaced by the advent of oil conversion.

B. The student will be able to describe those jobs resulting from the creating of electrical power and those replaced by this activity.

C. The student will be able to identify those job opportunities which were created and those which were reduced when coal displaced wood as a major energy source.

D. The student will describe career opportunities which have occurred as a result of nuclear power development.

E. The student will be able to list jobs which will be created as man converts the sun's energy to industrial uses.

IMPACTS OF ENERGY

GOAL: **It is essential that each person know how man's use of energy creates an impact on the environmental and economic systems.**

CONCEPT: I. Energy extraction and use alters original environmental conditions.

OBJECTIVE:

A. The student will know that gasoline fueled combustion engines endanger air quality.

B. The student will know that energy production plants affect environmental conditions.

C. The student will know that sewage treatment plants improve environmental conditions.

D. The student will know that petroleum and its derivitives degrade water environments.

E. The student will know that all air varies in the quantity of pollutants it carries.

F. The student will know all humans are polluters.

G. The student will know that energy extraction impacts the environment.

H. The student will know that intensity of energy use produces sociologic changes within and among human population groups.

CONCEPT: II. The use or non-use of any energy source requires environmental trade-offs.

OBJECTIVE:

A. The student will understand that the only lasting solution to declining energy resources is a world population decline.

B. The student will understand that any change in present energy use will affect employment patterns.

C. The student will understand that industrial and automobile emissions damage man-made and natural structures.

D. The student will understand that the site selection and design of industrial plants which use power involve environmental trade-offs.

E. The student will know that different energy users advocate different environmental trade-offs.

F. The student will know that different nations advocate different environmental trade-offs.

G. The student will know that the movement of people and goods requires environmental trade-offs.

H. The student will understand that the decisions people are willing to make about environmental trade-offs are based on internalized values.

CONCEPT: III. Various energy sources have differing impacts on the environment.

OBJECTIVE:

A. The student will understand that various energy sources and uses have differing impacts on the environment.

B. The student will understand that transportation and transmission of energy have an environmental impact.

C. The student will understand that different energy activity produces heat in differing amounts.

D. The student will understand that land use differs as energy use differs.

E. The student will understand that a marine environment reacts differently to oil activity than does a land environment.

CONCEPT: IV. Conflicts over ecologically sound practices and aesthetic judgments will involve trade-offs if they are to be resolved.

OBJECTIVE:

A. The student will understand that conflicts over ecologically sound practices and aesthetic judgments can be resolved.

B. The student will understand that some of these conflicts can be resolved by empirical processes.

C. The student will understand that some of the conflicts can be resolved by legal process.

D. The student will understand that some conflicts can be resolved by design processes.

E. The student will understand that some of the conflicts can be resolved by technological recycling processes.

F. The student will understand that some of these conflicts can be resolved by aesthetic processes.

G. The student will understand that some of these conflicts can be resolved by media-communication and economic processes.

CONCEPT: V. Efforts to regulate energy producers and users require energy, economic allocation and political effort.

OBJECTIVE:

A. The student will know that pollution control standards are a matter of legislation and law.

B. The student will know that the construction and abandonment of structures involving energy use are of concern to citizens.

C. The student will know that disagreement exists regarding the ways to control auto emissions.

D. The student will know that people holding different values differ in their attitudes regarding the need for more or new technical processes.

E. The student will know that new processes and devices to reduce pollution require energy use.

F. The student will know that existing and planned legislation may help or hinder the development of any industrial response to energy needs.

G. The student will know that different types of human activity require substantially different amounts of energy.

CONCEPT: VI. Some uses of energy are more threatening to ecosystems than are others.

OBJECTIVE:

A. The student will understand that some sources of energy are less threatening to biotic ecosystems than are others.

B. The student will understand that some ways of producing, transforming, and using oil are less threatening to biotic ecosystems than are others.

C. The student will understand that some human decisions involving energy use are less threatening than others.

D. The student will understand that stable human populations are less threatening to biotic ecosystems than increasing populations.

CONCEPT: VII. The environmental and economic consequences of energy use require additional energy.

OBJECTIVE:

A. The student will understand that the side effects of energy use requires additional energy.

B. The student will understand that energy use creates energy side effects.

C. The student will understand that the use of petroleum for energy creates side effects; energy is required to correct these side effects.

D. The student will understand that human use of products requires additional expenditures of energy for environmental and waste disposal purposes.

CONCEPT: VIII. Industrial societies have a greater impact on the environment than do agrarian societies.

OBJECTIVE:

A. The student will understand that most living Americans are personally heavy polluters.

B. The student will understand that all human activity - personally and collectively - releases heat into the biosphere.

C. The student will understand that industrial and consumer activity produces pollutants.

D. The student will understand that pollutants harm living substance.

E. The student will understand that most nations/states desire greater energy use.

F. The student will understand that improved living conditions have resulted from extensive energy use.

G. The student will understand that people in industrialized nations disagree about which environmental impacts are acceptable.

CONCEPT: IX. Maintenance or improvement of environmental quality necessitates large capital investment and/or reduced energy demand.

OBJECTIVE:

A. The student will know that maintenance or improvement of environmental quality necessitates large amounts of capital investment or reduced demand for energy.

B. The student will understand that air pollutants create economic loss.

C. The student will know that some industrial processes can use their waste products profitably.

D. The student will understand that sewage treatment plants use complex and expensive technology to improve environmental conditions.

E. The student will know that disagreements exist concerning the environmental quality to be secured, the capital allocations involved and the acceptable reduced energy demand.

CONCEPT: X. New technologies and careers have resulted from the environmental impact of energy.

OBJECTIVE:

A. The student will know that new technologies and careers have resulted from energy production and use.

B. The student will understand that new technologies have replaced or joined old technologies as a result of energy production and use.

C. The student will know that new careers have resulted from energy production and use.

LIMITS OF ENERGY

GOAL: It is essential that each person know that the earth's resources are limited.

CONCEPT: I. All sources of energy are limited; most can be used only once.

OBJECTIVE:

A. The student will understand what is meant by "limited" as related to energy resources.

B. The student will understand the terms "recycle" and "reuse."

C. The student will determine what forms of energy can not be reused.

D. The student will be able to describe the difference between renewable and nonrenewable energy resources.

E. The student will be able to explain how renewability or nonrenewability affects energy availability.

F. The student will be able to discuss personal activities which would extend the availability of nonrenewable energy resources.

G. The student will understand the relationship of "life style" to "finite energy resources."

H. The student will identify natural systems and describe their components.

I. The student will describe ways that man has upset natural systems in his quest for energy.

J. The student will understand the flow of energy from source to consumer.

K. The student will determine the flow of man-influenced energy conversion products into and through a natural system.

L. The student will understand how natural systems accommodate products from man's use of energy.

M. The student will understand the limits on energy use caused by the ability of earth's natural systems to accommodate effluents.

CONCEPT: II. Some energy sources are rapidly renewed while others are renewed so slowly as to be practically nonrenewable.

OBJECTIVE:

A. Fossil fuels are replaced within the earth in minute amounts each year.

B. Wood is a resource which is renewed rapidly within a human lifetime.

C. Falling water is a renewable resource.

D. Moving air (wind) has been and is an energy source in many parts of the world.

CONCEPT: III. Limitations may be viewed as relative to changing energy demands.

OBJECTIVE:

A. The student will understand the effects upon energy availability of various political (social), economic or environmental systems.

CONCEPT: IV. Knowledge and technology help develop and extend past, present and future energy resources.

OBJECTIVE:

A. The student will know factors that limit the technological growth and development of new energy sources.

B. The student will know examples where more efficient utilization of available energy is limited by man's ignorance or by lack of demand.

C. The student will know how a nation has overcome limitations of energy supplies.

D. The student will understand how start-up time lag limits the availability of new energy sources.

CONCEPT: V. Economic factors limit energy development and use.

OBJECTIVE:

A. The student will understand why there are economic constraints on development of energy sources.

B. The student will understand the economic benefits which result from either the development of new energy sources or changes in present sources.

C. The student will understand how dependence upon one energy source, domestic or foreign, is more limiting than development of a wide variety of energy sources.

D. The student will understand how the flow of dollars spent on energy sources affects the limits on energy use, conservation and waste.

E. The student will know the cost of energy in various societies.

F. The student will understand the economic effects of uneven distribution of energy resources in the world.

G. The student will understand that it takes energy to make energy.

H. The student will understand the need to use non-energy resources in developing energy sources.

CONCEPT: VI. Population change directly influences energy use, availability and supply.

OBJECTIVE:

A. The student will understand the correlation between population change and energy consumption.

B. The student will know the relationship between the standard of living and the limited availability of energy.

C. The student will understand the impact of limited energy supplies on the individual.

CONCEPT: VII. Societal actions influence, extend or exhaust available energy resources.

OBJECTIVE:

A. The student will understand how people have an effect upon decisions about themselves.

B. The student will understand how various political decisions can influence use of energy resources.

C. The student will understand and demonstrate how various segments of our society limit energy resource use.

D. The student will describe instances of how decisions benefiting short-term aims affected long term energy resources.

CONCEPT: VIII. Future technologies may be limited by existing resources.

OBJECTIVE: A. Developing technologies depend on availability of particular materials or capacities.

CONCEPT: IX. Limits of energy sources result in the creation of some kinds of jobs and loss of others.

OBJECTIVE: A. Changes in technology which may be required due to energy limits may result in great job displacement.

STUDENT PROJECTS

Included in the projects section is a list of various power and energy products (hands on type) for K-12 educational levels. Most of the projects can be modified to fit any level that you might desire to teach them in with a little ingenuity and imagination. There are projects that can be bought commercially as well as projects that can be built from various parts and pieces readily available.

It should be noted that this is not meant to be a complete list, but as examples of types of projects that can be used.

PROJECTS

A. Student Activities in Energy Summer Workshop UW-Stout 1977
UW-Stout EMC Menomonie, Wisconsin

B. Solar Electric Vehicle Design-Megatech-Energy Project and Experiments
cat. 1979 29 Cook St., Billerica Mass. 01866

C. Project and Title	Description	Sources
Electronics Projects Commercial	Electronic Kits, information and parts of all types	Graymark Electronics P.O.Box 17359 Irvine, CA 92713
Technical Systems Inc.	Prepared packages that contain: curriculum, equipment, & activities covering fluid power, electricity, & mechanical power, small engines & alternate energy	Technical Systems 2256 Terminal Road St. Paul, MN
Megatech Corp.	Commercially prepared projects in power & energy, starting from simple & inexpensive projects to complex & more expensive complete programs.	Megatech Corp. 29 Cook Street Billerica, Mass 01866
Ken Cook Educational Systems	They have commercially prepared packages (with equipment & curriculum) in small engines, welding, reading, employment, etc.	Ken Cook 12855 W. Silver Spring Dr. P.O.Box 207 Butler, Wis. 53007

EMPHASIS: Chemical

CONTRIBUTES TO ATTAINING OBJECTIVE(S): 1 and 3.

ENERGY SYSTEMS ELEMENT(S): Conversion, transmission, control.

INDUSTRY ELEMENT(S): (Wis. Guide) Research and development, energy, materials

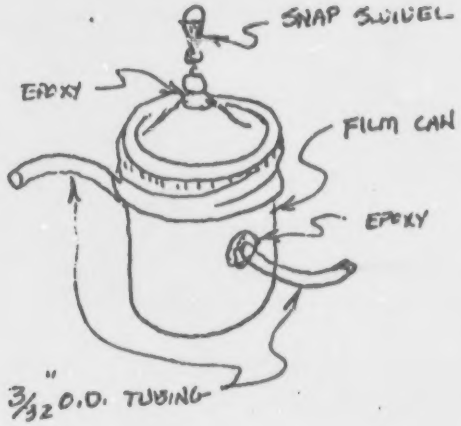
ACTIVITY:

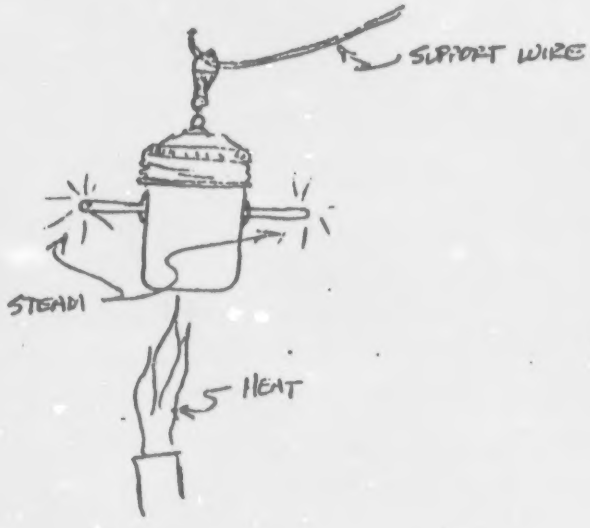
1. Given the supplies:
   - 1 coat hanger (or suitable wire)
   - 1 pipe cleaner
   - 1 #12 snap swivel (fishing tackle)
   - 1 pc. 3/32" O.D. Aluminum or brass tubing (hobby store) 2 1/2" long
   - 1 aluminum 35 mm slide film can with cover (or suitable container)
   - Epoxy Glue
   - 2 pcs. 3/8" or 1/2" dia x 2" dowel

Construct a small steam engine ("Hero's Engine") to convert chemical energy into heat energy and to mechanical energy.

SUGGESTIONS:

1. Cut two pieces of tubing 1 1/4" long.
2. Drill two 3/32" dia. holes opposite each other 3/4" up from the bottom of the
3. Slide the pipe cleaner into the tubing and using the dowels as a fixture, ben both pieces of tubing.
4. Drill a hole into the center of the lid and epoxy the round end of the snap swivel onto the lid.
5. Epoxy the two pieces of bent tubing into the holes on either side of the can. Let the epoxy harden.
6. Place about 3/16" of water in the bottom of the can and close the lid. Be absolutely certain that the tubes are not clogged, if they are, an explosion could occur!
7. Hang the engine from a piece of support wire and heat with a torch or bunsen burner.
8. As the engine spins, be careful of the steam escaping from the ends of the subes.





REFERENCES:

EMPHASIS: Fossil

CONTRIBUTES TO ATTAINING OBJECTIVE(S): 2, 3 and 4.

ENERGY SYSTEMS ELEMENT(S): (Source?) Conversion and conservation

INDUSTRY ELEMENT(S): (Wisconsin Guide) Research & development, energy, materials.

ACTIVITY:

Given a quart of contaminated oil, reprocess the oil by filtering, magnetic separ and siphoning. This activity may be given as a problem for the students to solve themselves or they may be guided through the solution.

Materials: (Instructor prepared) 1 qt. 10 W oil with steel filings, sand and water added.

1 - funnel
2 - glass beakers
1 - 6 x 6 cloth
1 - bar magnet
1 - piece tubing (for siphon)

SUGGESTIONS:

1. Shake the contaminated oil well.
2. Place the cloth into the funnel, the funnel over the glass beaker and slowly pour the contaminated oil into the funnel.
3. Move the magnet slowly through the filtered oil to attract any steel filings in the oil.
4. Allow the oil to stand in the beaker until it has risen above the water.
5. Pinch the end of the tube with pliers and insert it through the oil into the water and siphon off the water into another beaker.

REFERENCES:

INDUSTRIAL EDUCATION

ENERGY

WISCONSIN DEPARTMENT OF PUBLIC INSTRUCTION

EMPHASIS: Gravitational

CONTRIBUTES TO ATTAINING OBJECTIVE(S):

1, 2 and 3.

ENERGY SYSTEMS ELEMENT(S): Source, collection and conversion

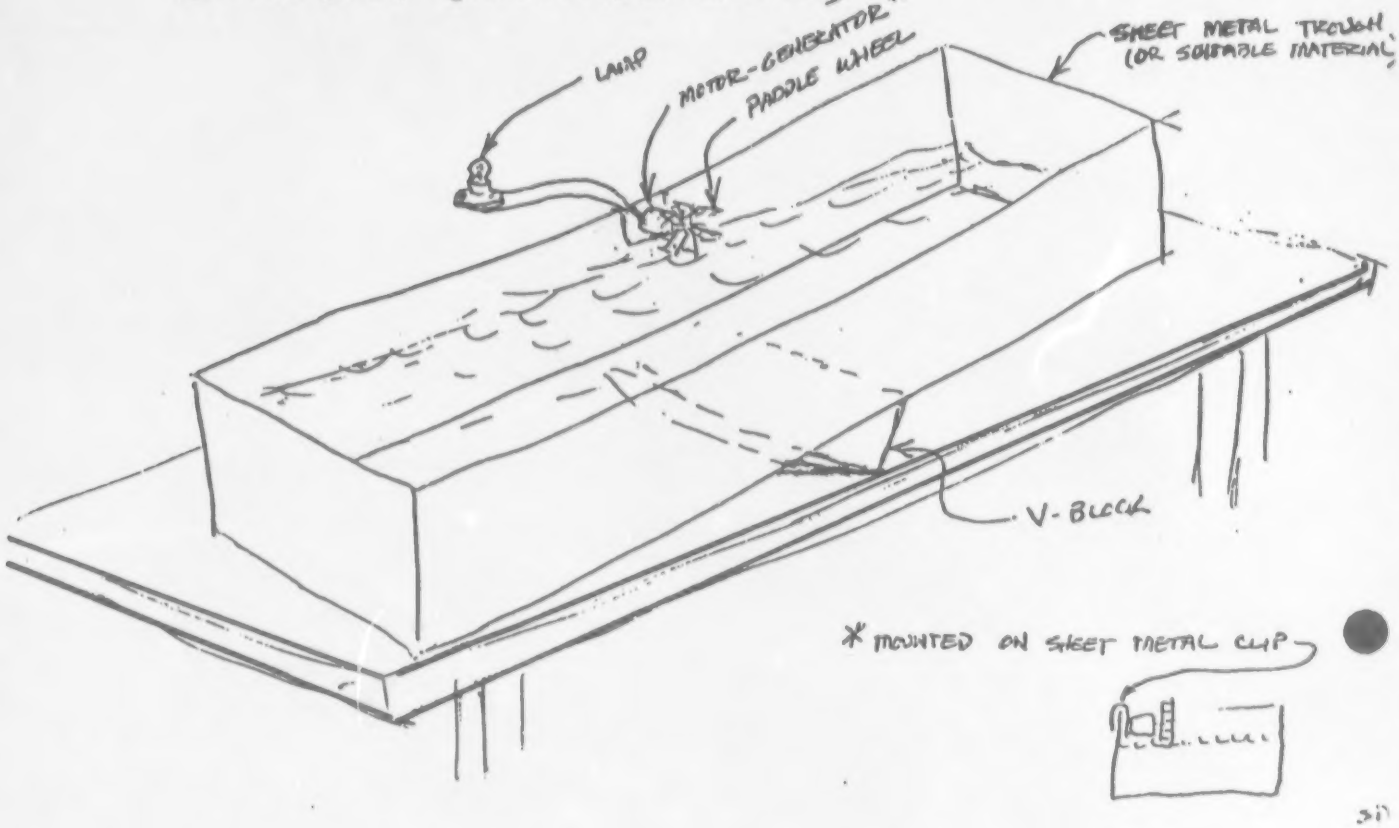
INDUSTRY ELEMENT(S): (Wis. Guide) Research and development, energy, materials.

ACTIVITY:

Shifting water in a trough to simulate a tidal generator. (Teacher demonstration)

(Model on other side)

SHIFTING WATER IN A TROUGH TO SIMULATE A TIDAL GENERATOR. (TEACHER DEMONSTRATION) *



* MOUNTED ON SHEET METAL CLIP

REFERENCES:

INDUSTRIAL EDUCATION

ENERGY

WISCONSIN DEPARTMENT OF PUBLIC INSTRUCTION

EMPHASIS: Mechanical transfer of energy

CONTRIBUTES TO ATTAINING OBJECTIVE(S):

ENERGY SYSTEMS ELEMENT(S): Transmission

INDUSTRY ELEMENT(S):

ACTIVITY: Students design and build a "mouse trap." This is supposed to be a very complicated device using simple machines. Requirements could be that students use 2 levers, 2 pulleys, 2 gears and an inclined plane. The device could have some kind of stored energy to operate the other simple machines. For example, students might include a rolling ball, falling weight on a string over a drum, a real mousetrap, or a battery and motor.

SUGGESTIONS: Show students some of the "inventions" of Rube Goldberg.

Stimulate students' imaginations to go far out in their design.

Work in groups to make material gathering easier.

REFERENCES:

INDUSTRIAL EDUCATION

ENERGY

WISCONSIN DEPARTMENT OF PUBLIC INSTRUCTION

EMPHASIS: Measurement of solar collection

CONTRIBUTES TO ATTAINING OBJECTIVE(S): To provide students the opportunity to work with energy systems.

ENERGY SYSTEMS ELEMENT(S): Storage, transmission, collection

INDUSTRY ELEMENT(S):

ACTIVITY:

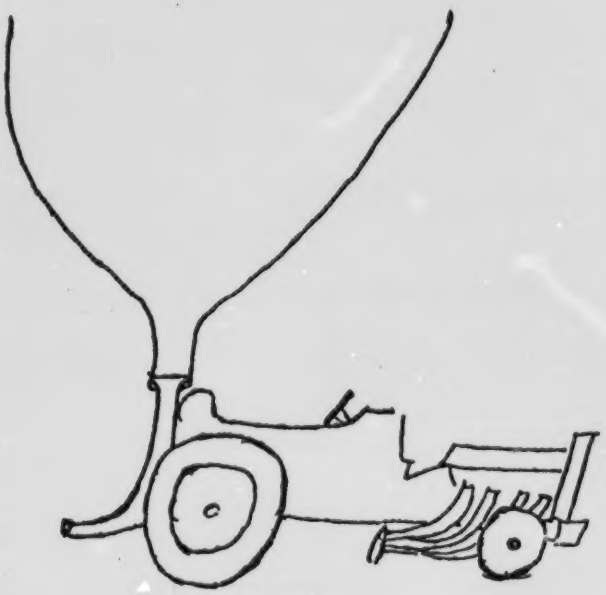
A partially inflated balloon will expand when the air inside it is heated. The amount of heat collected from a solar collector could be measured by the amount of expansion of the balloon. The efficiency of different collectors could be measured in this way.

1. Construct a small car powered by balloon power.

2. Construct a boat powered by balloon power.

SUGGESTIONS:

The inflated and heated balloon is connected to a small tube on the car or boat. The air escaping from the tube pushes the car ahead. The further the car moves demonstrates the amount of energy stored from the solar collector.



REFERENCES:

EMPHASIS: Conversion

CONTRIBUTES TO ATTAINING OBJECTIVE(S):

ENERGY SYSTEMS ELEMENT(S): Transmission

INDUSTRY ELEMENT(S): research, energy

ACTIVITY: D.C. Motor-generator

Any small permanent magnet, D.C. motor will act as a generator if the armature is turned by some outside power source. Using a pair of these small motors many interesting experiments can be set up.

1. Relative strength or power output of a windmill or water wheel can be easily checked. A motor can be hooked up as a generator to the output of the windmill. The output of the generator can then be measured.

2. Electricity generation and transmission can be demonstrated.

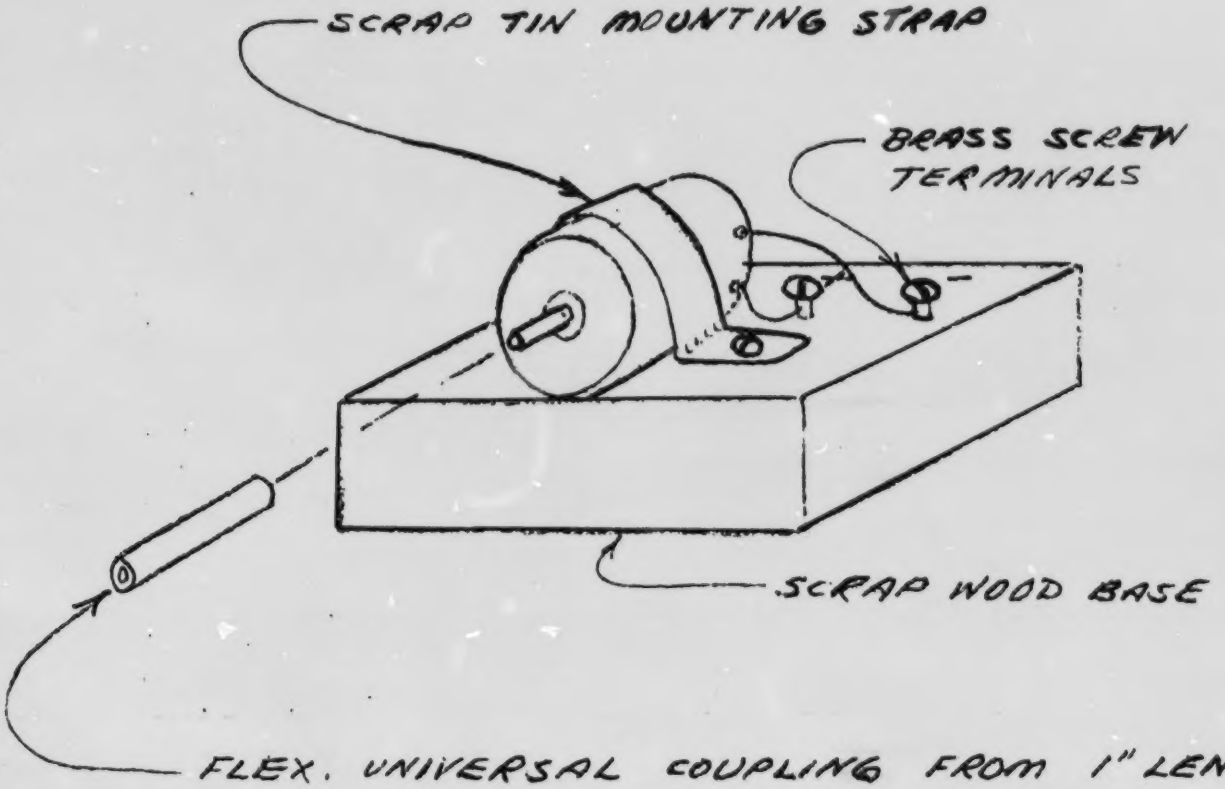
3. Line losses become evident if long transmission lines are used between generator and the load. This points out the disadvantage of low voltage D.C. transmission.

4. Losses between generators and motors can be shown. A generator is used to drive a motor. The motor will turn slower than the generator. A variety of experiments of this nature can be set up.

A good source of these motors is Kelvin Electronics Dist. from Tony Island, New York.

MOTOR - GENERATOR MODULE

USE A 1.5 - 3 V.D.C. PM MINATURE MOTOR


SCRAP TIN MOUNTING STRAP
BRASS SCREW TERMINALS
SCRAP WOOD BASE
FLEX. UNIVERSAL COUPLING FROM 1" LENGTH OF PLASTIC INSULATION STRIPPED-OFF #14GA. HOUSE WIRE.

NOTE: THIS MODULE SUITABLE FOR TESTING OUTPUT OF MECHANICAL SOURCES (CONNECT LOW RANGE VOLTMETER TO TERMINALS), AND ELECTRICAL SOURCES (INPUT TO TERMINALS).

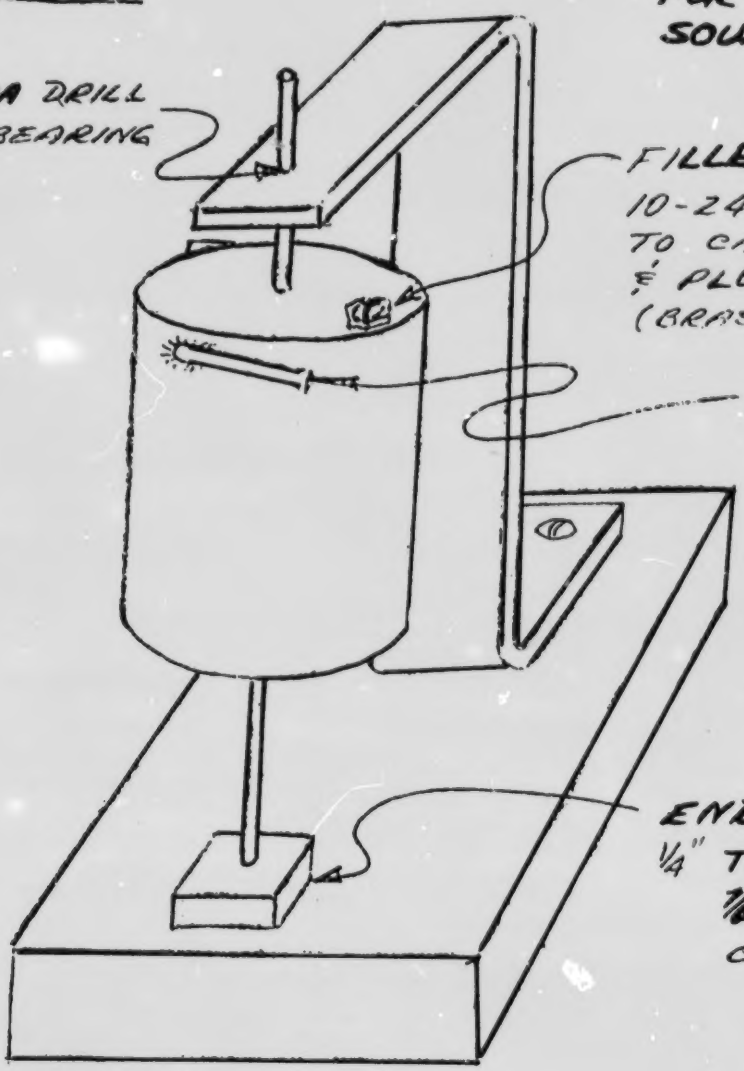
STEAM POWERED REACTION ENGINE

STUDENT ASSIGNMENT:

GIVEN THE MATERIALS, CONSTRUCT A STEAM POWERED CONVERTER BASED UPON HERO'S DESIGN.

NOTE:
USE PROPANE TORCH FOR ADEQUATE HEAT SOURCE!

EXAMPLE:


1/64" DIA DRILL FOR BEARING
FILLER OPENING - 10-24 M.S. NUT SOLDERED TO CAN TOP, DRILLED THRU, & PLUGGED BY MACH. SCR. (BRASS)
THRUST NOZZLES (2) SOLDER BRASS TUBE TANGENT TO CAN SIDES - PINCH ENDS ALMOST CLOSED TO REDUCE ORFICE SIZE (INCREASES THRUST).
END BEARING - 1/4" THICK ACRYLIC PLASTIC, 1/64" DIA. DRILL, 3/16" DP., CEMENT TO BASE.

MATERIALS:

2 3/4" DIA x 3 1/4" TIN CAN & SCRAP TIN LID SOLDERED TO TOP
3/32" DIA x 8" BRONZE ROD
3/32" DIA x 1" BRASS TUBES
ALUMINUM OR ACRYLIC FRAME STRAP
WOOD BASE BLOCK

GM

MATERIAL SOURCE FOR ENERGY ACTIVITIES

MATERIAL	USEAGE	SOURCE
Braze Rod 1/16", 3/32", and 1/8" Dia.	Machine Shafts & axles (easy to bend, solder, & rust free)	Welder's Supply
Brass tube 1/16", 3/32", 1/8", & 5/32" Dia.	Sleeve Bearings for shafts above	Hobby Shop
Acrylic Plastic Rod & Sheet	Pulleys - Lathe turned from laminated pieces	Allied Plastics I.A.S.C.O.
" " "	Bearings for shafts, drill 1/64" oversize	" "
Bottle caps	Pulleys formed by pop riveting two caps back to back	
Tin cans & can ends	Boilers, ducts, fans, etc.	
2 to 3 V.D.C. Motors	Generators & motors	Kelvin Electronics & Radio Shack
Emersion heaters Auto engine black heaters Alcohol lamp Candles	Water heating	Hardward stores Automotive supply
Auto hydraulic Master cylinder Wheel cylinder Hydraulic motors	Fluid power	Auto salvage
Screw Eyes	Shaft mounts & bearings	Herter's Inc. (fishing tackle)

A SEVENTH-GRADE UNIT IN POWER AND ENERGY

Richard Eide, *Industrial Education Teacher,*
Nokomis Jr. High School, Minneapolis, Minn.

The Power and Energy Program described in this article is a nine-week unit given to all boys and girls in Grade 7 at Nokomis Jr. High School, 3500 East 51st Street, Minneapolis, Minnesota 55417. The program was developed with funding from the District's Staff Development Budget. As the course was developed, the following criteria were followed:

1. The course must be coeducational.
2. Sex and racial bias will be eliminated not only in programming but also in content.
3. The program would be highly activity-oriented.
4. The course will be sensitive and responsive to ethnic issues.
5. The goals of career education will be supported.
6. Conservation of energy will be stressed.
7. Students will be able to identify new energy sources.
8. Students will understand how energy is converted into power.
9. Problem solving activities will be highlighted.

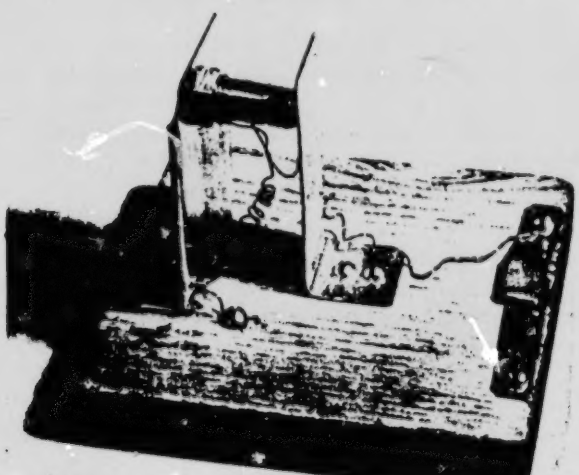


Figure 1

Electrical Energy

We are of the opinion that the junior high school student learns best by having as much "hands on" activity as possible and should have this activity as soon as possible after beginning the course of study. In preparing for this "hands on" activity we were concerned that the student grasp the theory of how this practical project operates as well as gaining skills in using tools and materials. For this reason, we began our course of study with an introduction to basic electricity and immediately started every student constructing a small, low voltage A.C. electric buzzer. (Fig. 1) This should be considered a very easy project to understand and construct, hence making it ideal for a first experience resulting in a positive experience. The knowledge gained from these experiences prepares the student for the remaining seven weeks of the course. The theories grasped are as follows:

Electromagnetism
A. C. Voltage
The basic series circuit
The electric switch
The step-down transformer

But by far the most important fact at this point is the hope that the student has a positive experience and feels the satisfaction of making something that "actually works."

Our second electrical project is a low voltage synchronous motor (Fig. 2) which takes us into motor theory. This demonstrates to students very vividly all energy is converted into power. These are the only electrical projects required by each student. While the students are working on these projects, we are covering related material which includes: electron theory, batteries, circuits, magnetism, motors, generators, basic appliances, and home wiring problems.

Steam

We next decided to move into the area of steam

energy. Our one project in this area is a small steam engine made from a one-half pint paint can, a small brass tube and some miscellaneous metal parts (Fig. 3). This project really gives the student the feel of steam power, is inexpensive and simple, yet shows

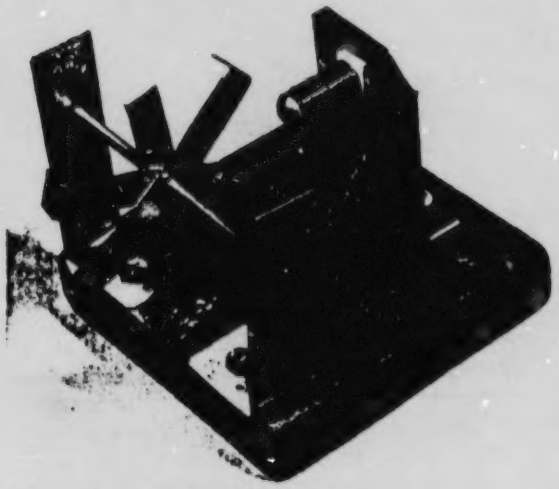


Figure 2: Synchronous Motor

very clearly how we obtain energy from steam. The boiler may be heated with sterno, a small propane torch, electric heater or even on a gas stove.

The little steam engine project also opens up the opportunity to challenge the student to do something often difficult but always interesting and creative. The student is encouraged to design his/her own wheel in

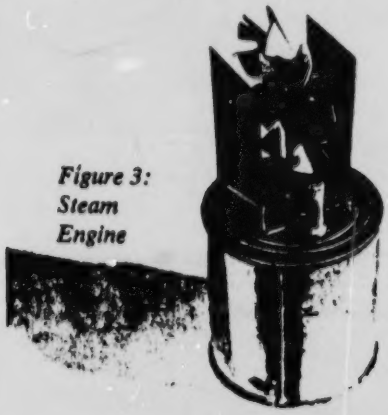


Figure 3: Steam Engine

order to attain more speed, run at a lower heat, and run for a longer period of time. Experiments and exchange of ideas are exciting and interesting ways to learn. The related information on steam energy includes the study of steam engines and steam turbines which some day may power our automobiles down the highways.

Wind

Our next work is in the area of wind energy. The one project in this area is a small 5" diameter six-bladed rotor made from a metal disc and a ¼" bolt (Fig. 4). From this point, the student creates and designs his/her own wind machine to be driven by the 5" blade. This is another opportunity for the student to be creative and engage in some individual problem solving.

The basic idea here is to discover and experiment with different ways of utilizing the energy from wind. The student must design and build all the mechanism to transfer the wind energy through the turning propeller into some type of mechanical energy. Hopefully, this mechanism would be a model of a machine that

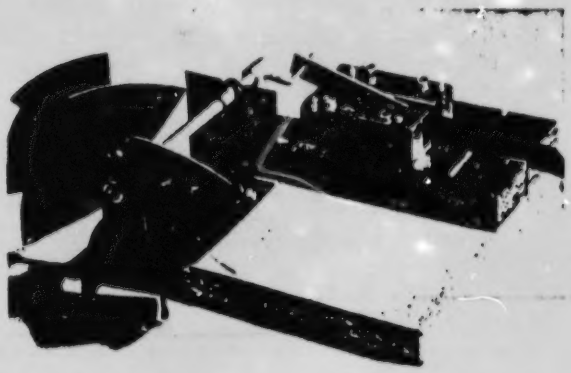


Figure 4: Wind Operated Machine

could actually do some type of work. It has been really interesting and fun to see the ideas that the students have come up with, many of the better ones built by girls. Many are brought home as homework assignments and involve the help of parents and older brothers and sisters.

Another wind energy project was a wind generator which was accomplished as a class project (Fig. 5). We picked up a surplus permanent magnet of considerable strength and mounted it on a block of wood. We then took some universal appliance motors apart and found an armature adequate for the project. Our next step was to make a 28" diameter, four-blade rotor and connect it to the armature. The electrical power generated is quite small but it is enough to light a small light bulb and has given many students the chance to really see exactly how wind can be converted into electrical energy. As the student works with the wind

generator he is naturally learning the principles of magnetic induction, motors, generators, brushes, commutator segments, blade pitch and the most efficient number of blades. We are currently working with other types of wind generators utilizing other types of blades, bicycle generators, etc.

Figure 5: Wind Generator

Solar

The field of solar energy offered two basic projects, a solar heat box (Fig. 6) and solar electric cell experiments. The solar heat box is simply a small wooden box approximately 10" x 10" x 4" with one glass surface, one removable end and a standard inexpensive thermometer mounted inside.

After these specifics, the student then has individual input which includes insulating the box, putting in more than one pane of glass, possibly using plastic instead of glass, spacing of the plastic and the glass, types and positions of reflectors and baffles. On a given day students place their solar heaters side by side either inside the building or outside depending upon space and weather conditions and a contest is on to see who can develop the most heat. Students may decide to make engineering changes and have another

Figure 6: Solar Heat Box

contest later. This develops some excitement and fun along with the learning process.

This is as far as we have gone with solar heating from the project standpoint. We do, however, go into the entire heat storage and circulating process in diagram form.

Hydraulics

We are currently in the process of developing an inexpensive simple hydraulics project using copper and/or plastic tubing but at the time of this writing we have not yet perfected the project.

Vehicles Powered by Various Energy Sources

Power and energy fit together very well so we have introduced some project ideas that include go-cart building, various types of self-propelling vehicles (rebuilding bicycles) electric vehicles such as go-carts and bicycles to show how energy is converted to power. In this power and energy class each student was given a small 10-volt DC motor and two wheels. He/she was then required to design and build a land or air vehicle (Figs. 7, 8, 9) to be driven by that motor with some type of propeller blade. Most of the vehicles were made from tin and soldered together. We then made a balanced tubular tether on which to fly and propel air-borne vehicles around. Principles of aerodynamics, wind resistance, and structural strength are discussed at this time. Upon completion, three or four days are spent flying or driving these cars, rockets, helicopters and airplanes. The helicopters and airplanes are flown

Figure 7: Vehicle Project

around the balanced tether. Because it is ballanced with a counterweight, very little lift is needed to get the vehicle airborne.

Air Suspension

The advent of air hockey games in the last year or two has provided some opportunities to experiment with model suspension vehicles. Using a vacuum forming press, we made various model vehicles which would float across the surface of the air hockey table. The challenge here was to design a vehicle which would travel on the lowest air pressure, and would travel horizontally at the greatest speed.

The Electric Piston Motor

By attaching the core of a solenoid with aluminum or copper tubing to a connecting rod and fly wheel, an electric piston motor is constructed. The electric piston operates on the principle of the piston being pulled into the cylinder by the magnetic field when the circuit is momentarily energized by the contact points. From the utilization of energy standpoint, the interesting point is that the motor only draws current during the time that the piston is being pulled into the cylinder and the fly-wheel does the rest of the work. This project helps students to appreciate the fly-wheel as an alternative energy source.

We have been trying to make our course in energy creative, relevant, and practical. We want our students to think, create, build, experiment and rebuild. We want them to feel that this subject matter is important and that what they as students have to contribute is important. During the unit, contributions made by various ethnic groups to developing, conserving and converting energy into power were highlighted. This was done by field trips, guest speakers and research projects.

Figure 8: Vehicle Project

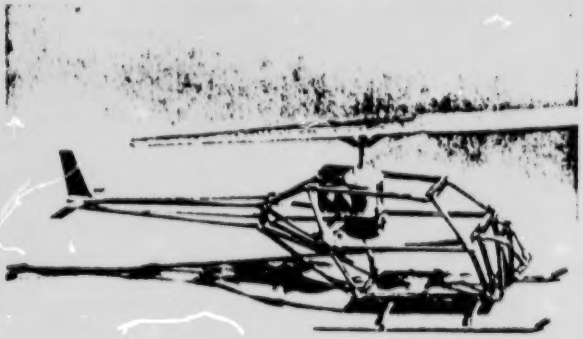


Figure 9: Vehicle Project

ACTIVITY LIST

CONCEPT MEASUREMENT: Exposure to English/Metric System

CURRICULUM ORGANIZER Basic Information

OBJECTIVE The Student will be able to identify: terms; units; and conversion-type proportions between the English and Metric Systems

RESOURCES	ACTIVITIES	EVALUATION
The Metric System, by Don H. Parker. National Book Company.	(A) The Student will take the pre-test for measurement. From the results he will perform the prescribed tape(s) activities. OR If the results are above average, the Student can skip the tape activities. AND The Student will complete one activity in measuring Distance and one activity in measuring Mass from the choices listed on the following activity list.	Evaluation will be based on achievement with pre-test. 80% of the possible points on the pre-test allows student to miss the tapes. Evaluation will be based on performance of the activity stated on following activity list.

Shawano I.E.C.P.

NAME_____

CLASS TIME, ____AM ____PM
(check one)

PRETEST FOR METRIC MEASUREMENT

Since much of energy is measured in scientific notation and the Metric System. I have provided a means to help me determine where you should actually start in a following unit. Please answer questions as honestly as possible. The results of this test will be used only for my purposes and will no way reflect on your grade, thank you.

Please place the correct letter in the proper blank.

____1. The hardest thing about the Metric System is:

A. Deciding number size because everything is based on multiples of 10.

B. Converting from the English to Metric or Metric to English.

C. It does not apply to most of the people of the world and therefore is useless.

D. There is nothing hard about it.

_____2. 1,000 can be written $10^{?}$ POWER and is considered 10X10X10.

A. 2
B. 3
C. 4
D. Not really sure

____ 3. One inch is roughly _____Centimeters?

A. 4 centimeters
B. 3 centimeters
C. 2 1/2 centimeters
D. Not really sure

_____4. There are _____centimeters in a Meter.

A. 100
B. 10
C. 1000
D. Not really sure

_____5. A Meter is longer than 1 yard by roughly _____.

A. 1 1/2 inches.
B. 6 inches.
C. 3 inches.
D. Not really sure

_____6. The prefix Milli is what fraction of anything?

A. 1/100
B. 1/1000
C. 1/10,000
D. Not really sure

_____7. 1 pound is just about _____Kilogram(s).

A. 1
B. 1/2
C. 3
D. Not really sure

_____8. A Kilogram means that there are _____grams in this unit.

A. 10^3
B. 10^4

C. 10^5
D. Not really sure

_____9. The names foot and yard are based on:

A. The same measurement
B. Body measurements
C. The size of a horse
D. The yard arm of a ship.

_____10. An OHM is a measurement of resistance for Electricity. If a person had a MegOhm resistor, how many units of ohms would you have?

A. 10,000
B. 100,000
C. 1,000,000
D. Not really sure.

Certain questions tell me what you know about certain areas in the metric system. If you receive an 80% or better,(that is 8 out of 10), you might be able to bypass the next unit, although I might ask you to answer a few questions verbally first.

The questions are divided into three main catagories:

I. METRIC TERMS
II. CONVERSION
III. SCIENTIFIC NOTATION

If a majority of questions are missed in I,II,or III or a combination of any, this suggests work in these areas. Activity contracts for working on these areas will be provided

Shawano I.E.C.P.

ACTIVITY LIST

CONCEPT Application of Light Energy

CURRICULUM ORGANIZER
LIGHT ENERGY

OBJECTIVE Construct a pireascope for locking over crowds or around cornners

RESOURCES	ACTIVITIES	EVALUATION
Working Drawings Bill of Material Procedure Sheet TOOLS & MATERIALS 2" x 2 3/4" Mirrors Cardboard Tube Glue or Tape Knife, Sissors, Timing Light Dwell Meter	1. Obtain materials and equipment from instructor 2. Read working drawing, make a bill of material. 3. Write the steps of the procedure used to construct the pireascope. 4. Layout, cut, bend, glue, and assemble tube. 5. Cut out ports and insert and glue mirrors. 6. Check alignment of mirrors with location lines. 7. Review the incedense and refraction of light.	Students will be evaluated on the basis of project workmanship, technical details, completeness, accuracy, scope and significance, clarity, written presentation and oral presentation

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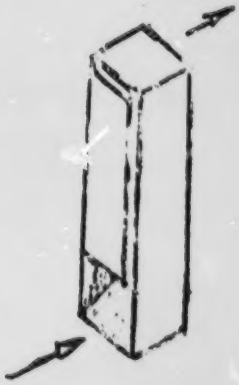
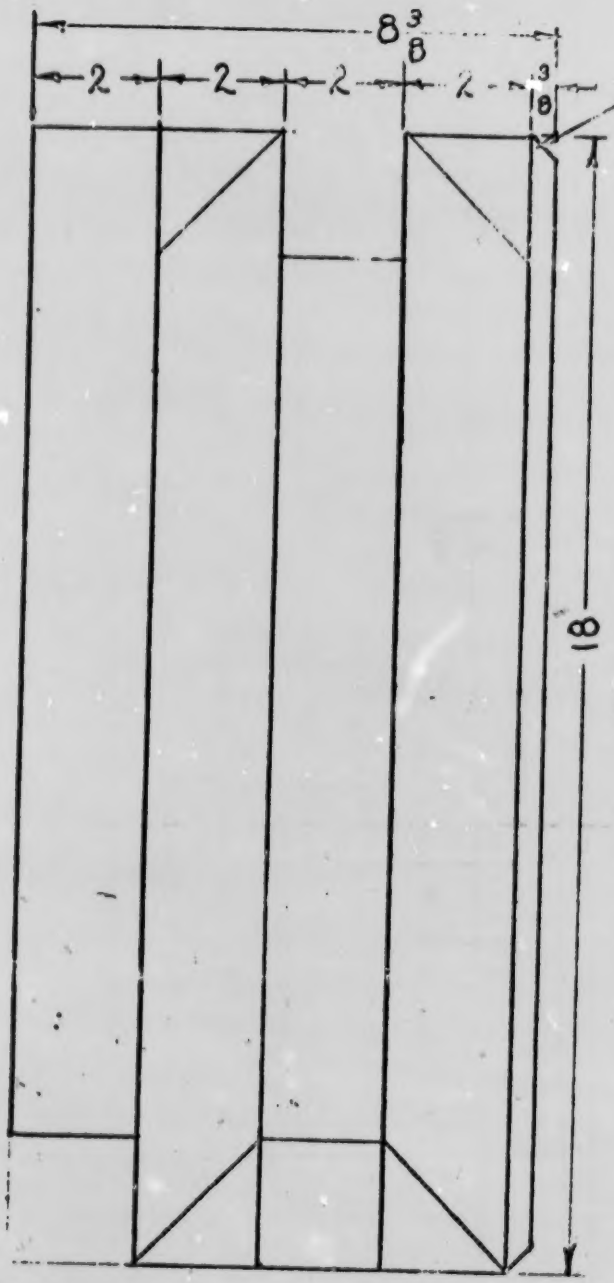
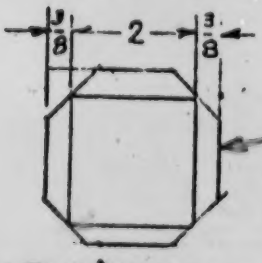
PIREASCOPE TUBE.





CUT TABS AT 45°



3/8 TABS, FASTEN WITH CEMENT

NOTE: FRONT IS CUT-OFF SO AS NOT TO OBSTRUCT VISION

CUT MIRROR GLASS 2" X 2 3/4"

TOP & BOTTOM

Materials

1 Sheet of heavy tag-board 8-3/8" X 18"
2 Pcs. of heavy tag-board (for top and bottom) 2-3/4" X 2-3/4"
2 Pcs. of silvered glass mirrors 2" X 2-3/4"
1 Tube of Duco cement
1 Roll of 1/2" tape

Tools and Equipment

Ruler
Pencil
45° Triangle
T-Square
Scissors
Glass cutter
Box and pan break

Procedure

1. Obtain and read a working drawing.
2. Lay-out tag-board (sides) using dimensions found on drawing.
3. Locate and cut out ports for mirrors. Refer to drawing.
4. Locate bending lines and lap-lines, then bend, form, and glue joints.
5. Obtain mirrors, cut to size, make locating lines at 45 degrees.
6. Cover mirror edges with Duco-Cement and place mirrors in tube on location lines. ALTERNATIVE METHOD: Use tape to fasten together.
7. Allow cement to set.
8. Cut-out the bottom and top from the tag-board, glue edges, place in position and allow the glue to set. See drawing for dimensions.
9. Again check angle (45°) of mirrors with location lines.
10. When the glue has set, place scope in position and view through the bottom port. WISHING YOU HAPPY VIEWING DURING THIS BICENTENNIAL YEAR!!

NOTICE: Any modification and improvement should be called to the attention of the instructor as you may receive extra credit for your creative efforts!!

Shawano I.E.C.P.

CONCEPT Measurement of Energy

IND. ED. LEVEL II

CURR. AREA Energy IC

GEN. OBJ. Become familiar with measurement classifications and units of measurement.

UNIT IV. Measurement of Energy

RESOURCES	ACTIVITIES	EVALUATION
1. References: Sterland Halacy Time-life(energy) Time-life(machines) Duffy Gerrish 2. Teacher 3. Students 4. Small Engine dynamometer 5. Thermoelectric gen. test unit 6. Solar cell test unit 7. fuel cell test unit 8. Hydraulic-pneumatic test unit 9. Lab-volt exp. kit	--Read assigned references --Discussion concerning measurement of energy; classifications and units including metric --Experimentation --measuring: Distance in meters and yards, etc. Time Mass in metric and English Temperature in ^{o}F and ^{o}C Electricity--Amps, Ohms, Volts Light--Ft. candles, lumins various test devices --use to calculate Torque Horsepower Work Pressure --Solve problems concerning electrical units of measure --Calculate displacements of engines	Given a list of measurement classifications and a list of units of measurement, the student will match the units with their classifications. Given a list of classifications of measurements the student will identify two measure devices for each. The student will measure the following: Distance Time Mass Temperature Electricity (AC & DC) Light Experimentation through the student will obtain measurements necessary to calculate the following measurement interrelationships Work Pressure Power Velocity R.P.M.

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Shawano I.E.C.P.

TITLE OF CONCEPT, LEARNING EXPERIENCE Comparison of Different Metals and Their Ability to Conduct Heat.

THIS PACKAGE WILL HELP YOU LEARN ABOUT The conduction of heat by different metals

BY THE TIME YOU FINISH THIS PACKAGE YOU WILL BE ABLE TO:

A. Set-up an experierental appratus and measure the ability of iron, zinc, copper, and aluminum to conduct heat from

B. a constant heat source(Electric Hot Plate)

Collect data and summarize (rank in order) the metals ability to conduct heat. ORGANIZE YOUR IDEAS TO EXPRESS THE above conclusions.

TO HELP YOU REACH YOUR OBJECTIVE ON Conduction of heat by different metals (A comparison).

YOU SHOULD USE AT LEAST ONE OF THE FOLLOWING RESOURCES, LISTED TOOLS, EQUIPMENT AND MATERIALS:

MEDIA: (List)

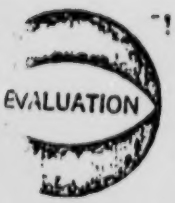
BOOKS (List): Look-up ATOMIC WEIGHT of the different metals in a chemistry or physics book

TOOLS & MATERIALS: (List) Hot plate, thermometers, containers, H_2O, Gloves, watch, Metals: Iron, Zinc, Copper, and Aluminum.

NOW THAT YOU HAVE LOOKED AT SOME OF THE RESOURCES, DO THE FOLLOWING ACTIVITY:

Instructional Procedure: (In Steps)

1. Obtain the above listed equipment.
2. Fill beaker 3/4 full of H_2O. Measure temppture of water.
3. Turn on hot plate, heat metal(5minutes). Insert metal into beakerand quickly read tempature (Max.) rise.
4. Record temp. rise of water for each heated metal.
5. Write up a lab. report including your observations and conclusions on the heat conducting ability of each metal. Rank them in order.



AFTER FINISHING THE ACTIVITY, LIST THE CRITERIA YOU WILL USE TO ASSESS MASTERY OF THE ABOVE CONCEPT, SKILL OR ATTITUDES FOUND IN THIS LEARNING EXPERIENCE:

1. Instructor review results of Lab. report.
2. For accuracy, completeness and neatness.

(Use other side if necessary)

Shawano I.E.C.P.

ACTIVITY LIST

CONCEPT NATURAL FLUID POWER: Wind or Water Usage

CURRICULUM ORGANIZER

NATURAL SOURCES

OBJECTIVE Given the Student the proper materials required, he will demonstrate through problem solving, how to design and utilize a Fluid Power converter.

RESOURCES	ACTIVITIES	EVALUATION
Designing a Windmill Blade by T. F. Kressin Designing a Waterwheel Blade instruction sheet by T. F. Kressin	1. The student will design and/or construct a windmill blade and test it to meet specifications established. (Wind Activity #1) AND The student will take this windmill blade and apply it to a windconverter of his own and/or group design. (Wind Activity #1B) OR 2. The student will design and/or construct a waterwheel blade and test it to meet specifications. AND The student will take this waterwheel blade and apply it to a waterconverter of his own and/or group design. QUEST ACTIVITIES WHICH WILL BE COMPLETED BEFORE TARGET GROUP REACHES FLUID POWER ACTIVITY: (X) The student will construct wind blade test stand to specifications which will be used with compressor. OR (XX) The student will construct a waterwheel landscape to specifications to be used for water converters.	Evaluation will be based on performance test. Evaluation will be based on form on back of contract. Evaluation will be based on performance test and appearance. Evaluation will be based on form on back of contract. Evaluation will be based on specifications on drawings/contract.

CONTRACTED LEARNING TASK

Shawano I.E.C.P.

NATURAL SOURCES: Wind Power Activity#1

INDIVIDUALIZED INSTRUCTION

Power and Energy

Name_____

Estimated Completion Time_____ Mods

Date Started_____
Date to Complete_____
Date Completed_____

Resource Materials: Carving knife; 6"X3/4"X3/4" piece of stock; Compass and pencil; straight edge; Test stand; Instructor's standard for blade; instruction booklet; newspaper to catch all the shavings.

Student Activity: Listed is a clear-concise list of statements telling you the student what to do and how to do it for this unit of work.

1) Get all the materials needed.

2) Read over instructions in booklet.

3) Carve blade out according to standard or your own design. (if you cut your own design, it still must pass the
4) performance test stated in #8 and #9.

5) Make sure blade is balanced, and smooth.

6) Mount onto erectorset shaft, preferably the longest one.

7) Place into test mount and prepare to test your blade.

8) Make sure the blade balances parallel with the table(1st test)

9) From a dead stop, apply 25 lbs of pressure to test stand. The blade must rotate on its own. You have three tries to do so.

10) Evaluation is strictly performance based and must pass to go on to the next activity.

Special Instructions: Please becareful when you are carving on this blade, and always carve away from you. It might be necessary for you to bring your own jackknives. If you do, use them only in my class for carving wood other wise they will be taken away.

Student Signature _____ Instructor Signature _____

Date_____

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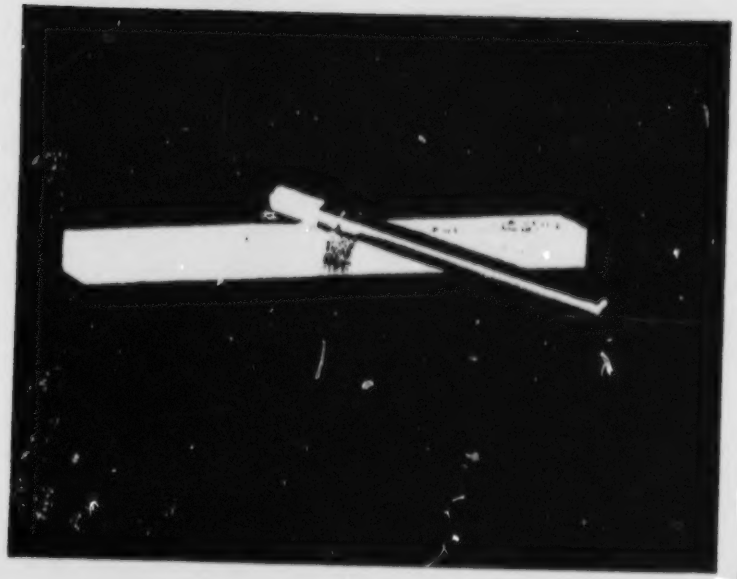
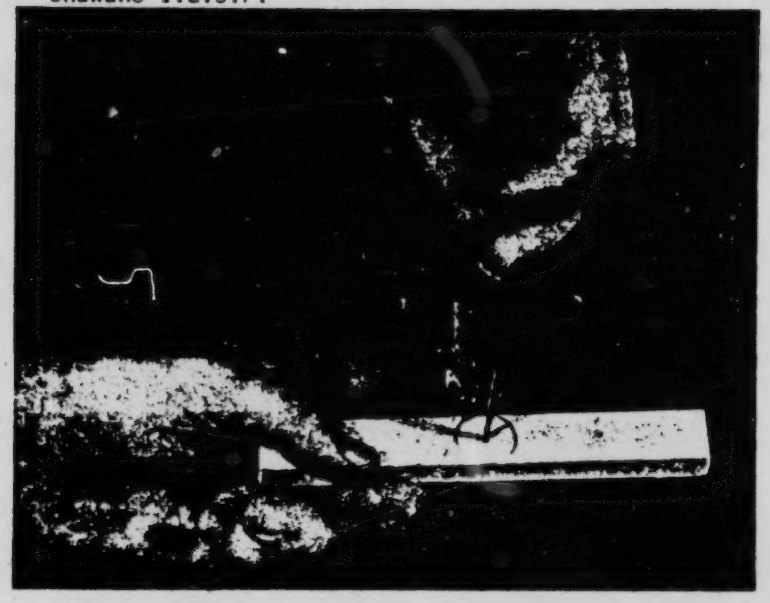


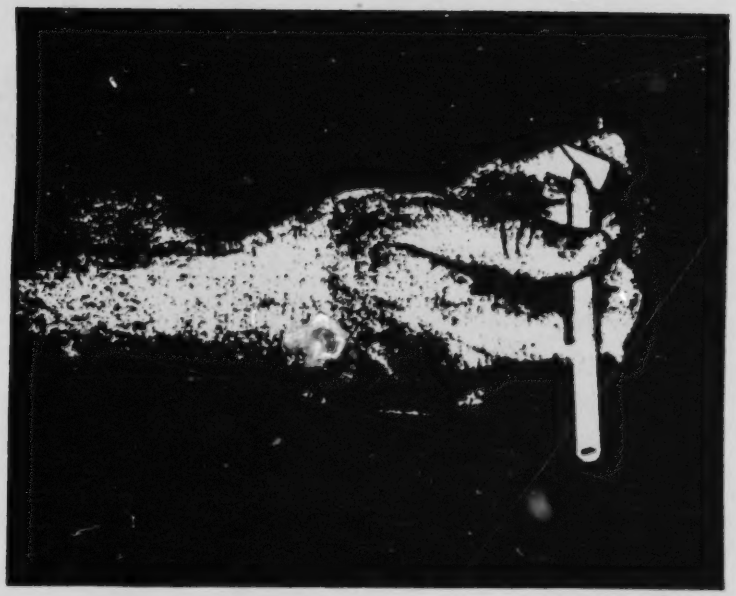
TAKE A PIECE OF 6"X3/4" STOCK OF PINE WOOD. YOUR INSTRUCTOR WILL PROVIDE YOU WITH THIS MATERIAL.

NOTICE, THERE IS A 1/8" Dia. HOLE DRILLED THROUGH THE CENTER OF THE STOCK.



NEXT TAKE A STRAIGHT EDGE AND DRAW A DIAGONAL ON ONE END OF THE STOCK.

TAKE A COMPASS AND DRAW A 3/4" DIAMETER CIRCLE ON BOTH SIDES OF THE STOCK USING THE DRILLED HOLE AS THE COMPASS CENTER...THIS WILL BE THE SHAFT AREA**



HOLD STOCK SO FINGER AND THUMB ARE OVER THE CENTER OF THE HOLE.

***NOTE WHERE THE HIGH POINT OF THE DIAGONAL IS....

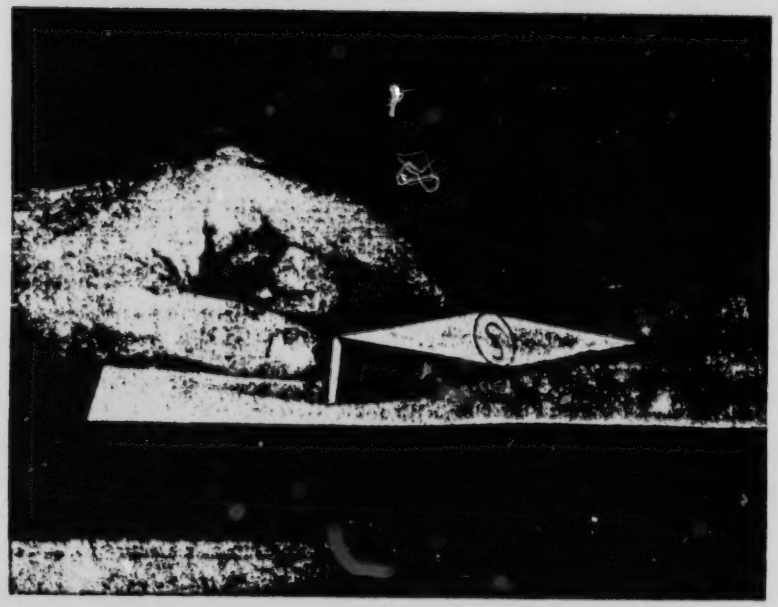
NOW ROTATE STOCK 1/2 WAY AROUND SHOWING THE OTHER END.

DRAW THE OTHER DIAGONAL EXACTLY AS BEFORE WITH HIGH POINT OF DIAGONAL IN THE SAME CORNER.

IS THE DIAGONAL IN THE SAME POSITION AS YOU ROTATE IT END TO END??
CHECK WITH THE LAST 3 PICTURES TO SEE IF IT IS RIGHT.....

NOW YOU HAVE THE PITCH OF THE BLADE DRAWN OUT. WHETHER YOU CONTINUE WITH THE STANDARD DESIGN OR DESIGN YOUR OWN TRY AND STAY WITH THIS PITCH ANGLE.

IF YOU WISH TO DESIGN YOUR OWN BLADE, LEAVE THIS PACKAGE AT THIS TIME AND COME UP TO TELL YOUR INSTRUCTOR....



TO FINISH LAYING OUT THE STANDARD BLADE, DRAW DIAGONAL LINES AS ON THE LAYOUT BLOCK YOUR INSTRUCTOR HAS. ALL AREAS THAT ARE SHADED WILL BE CARVED OUT... SHADE IN THE AREAS OF YOUR OWN IF IT WILL HELP YOU GUIDE YOUR CARVING.

START YOUR CARVING OUT OF THE SHADED AREAS THAT YOUR LAYOUT LINES SURROUND.

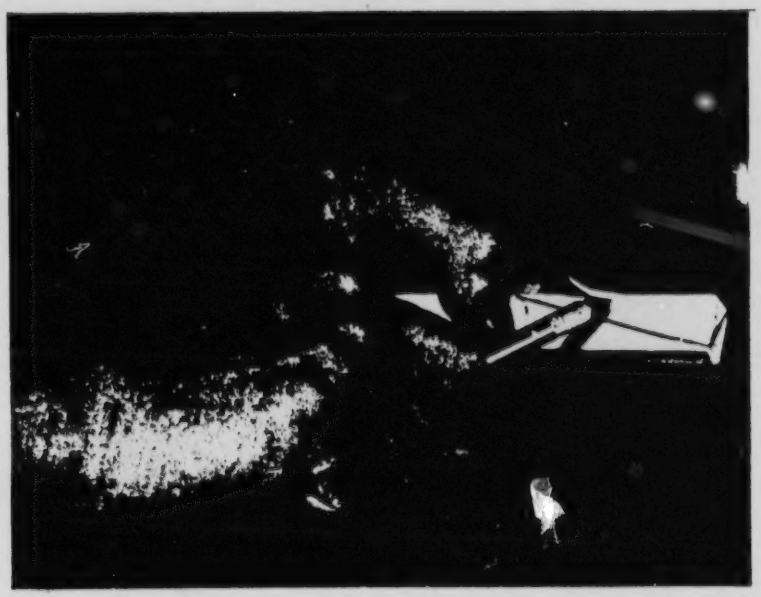
HERE ARE A FEW THINGS TO REMEMBER WHEN CARVING:

1. Carve thin slivers at a single stroke. It's easier to take more off later than to put it back on!

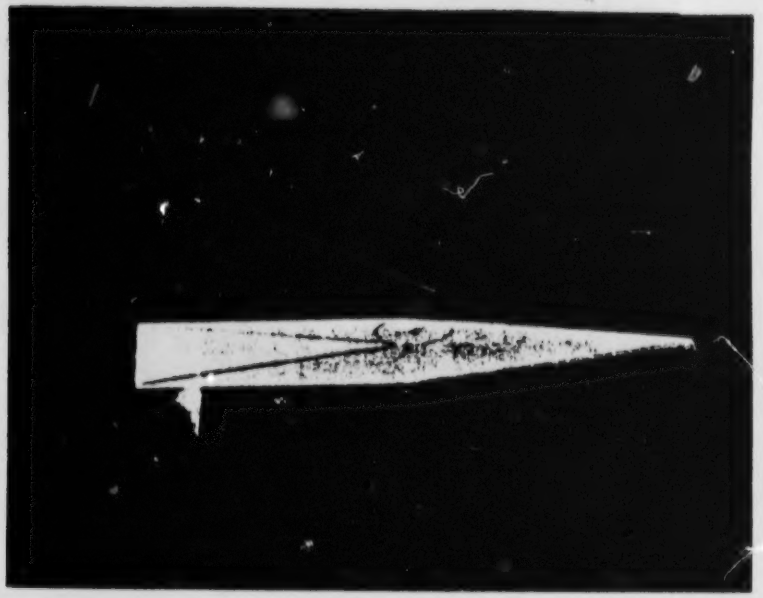
2. Always carve away from you!! Do this to prevent possible injury.

3. Carve your blades the same size on both ends...they have to be balanced.

4. Even though this is not a woods class craftsmanship is still important. The better it looks; the more it is balanced; the more power you will get from your blade...and THAT is how you will be evaluated.



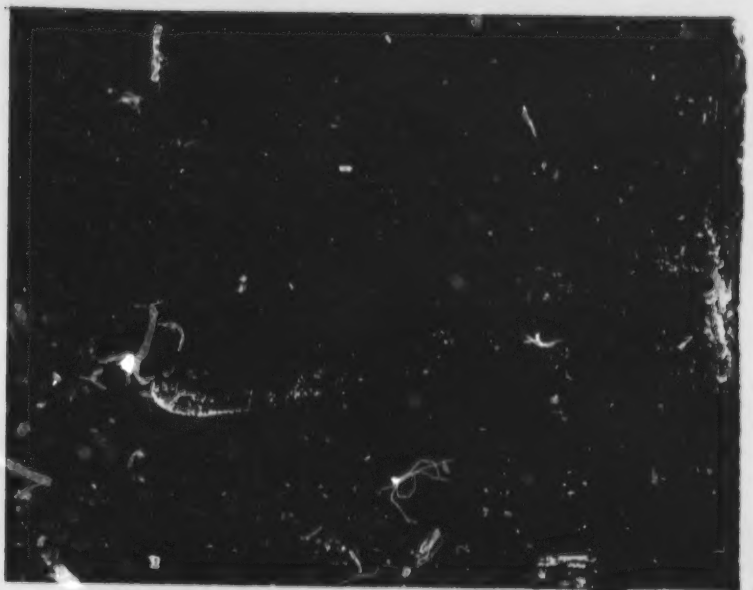
ONCE YOU GET ALL THE SHADED AREAS CARVED OUT, YOUR STOCK SHOULD LOOK LIKE THIS:



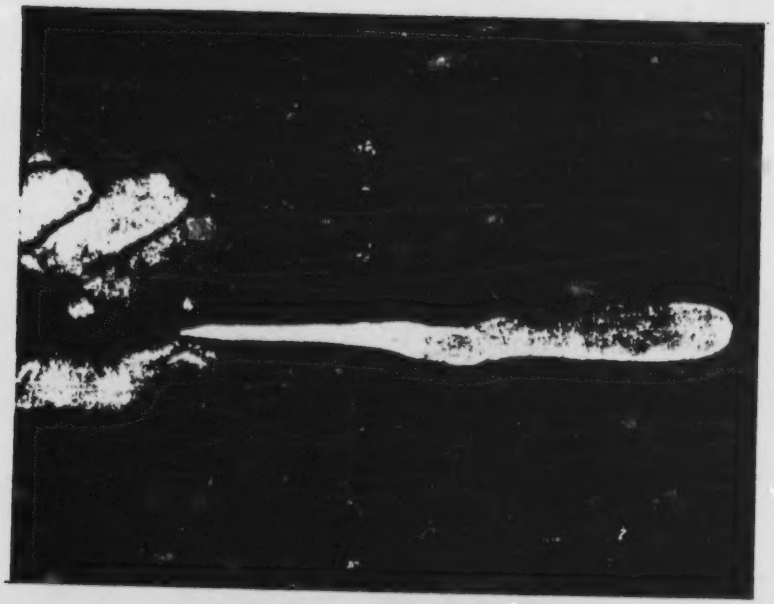
NOW CAREFULLY ROUND OUT THE BLADES AND GIVE THEM THE CONTOUR LOOK THAT YOU'RE USED TO SEEING ON BLADES.

REMEMBER...A PROPELLER OR WINDMILL BLADE IS DESIGNED WITH BALANCE. IT IS IMPORTANT YOUR BLADE IS BALANCED FOR BETTER OPERATION.

ONCE IT IS BALANCED AND SHAPED, SAND YOUR BLADE SMOOTH TO CUT RESISTANCE.



TO TEST YOUR BLADE, AN ERECTOR TEST STAND IS PROVIDED TO TEST IT. IT MUST ROTATE FROM A STOPPED PARALLEL POSITION. 25 POUNDS OF PRESSURE CAN ONLY BE APPLIED FOR THE TEST. YOU WILL HAVE THREE TRIES TO ACCOMPLISH THE TEST.



*NOTE: IT MAY BE NECESSARY TO PRODUCE MORE THAN ONE BLADE TO ACCOMPLISH ACTIVITY 1-B, WHICH FOLLOWS THIS ACTIVITY.

YOU SHOULD HAVE A SMOOTH, BALANCED BLADE READY FOR OPERATION. *

PROJECT PLANNING SHEET

This form must be carefully filled out and OK'D before starting.

Name_____ Date_____

Type of Project_____ Source of idea_____

_____

Draw a freehand sketch of what the finished project will look like. Please include all <u>important</u> construction details & dimensions.

Estimated time to Complete_____ OK

Actual Time_____

Shawano I.E.C.P.

CONTRACTED LEARNING TASK

NATURAL SOURCES: Wind Activity #1-B

INDIVIDUALIZED INSTRUCTION

Power and Energy

Name_____

Estimated Completion Time_____ Mods

Date Started_____
Date to Complete_____
Date Completed_____

Resource Materials: Windmill blade; 3 or 4 pe ple; Project planning sheet; Erectorset parts that you need; tools from the tool cabnet; other materials needed other than standard.

Student Activity: Listed is a clear-concise list of statements telling you the student what to do and how to do it for this unit of work.

1) Construct Windmill blade to specifications as in Activity #1.
2) Form a group of 3 or 4 people that you normally don't work with.
3) Read the requirements on the back of the Contract.
4) Together come up with a planned due date after reading rest of the contract.
5) Design a wind converter which will change wind to a useful kind of energy/work.
6) Draw a sketch of your combined ideas and submit for approval.
7) By using an erector set, build this wind converter.
8) Extra materials, such as electric generator; conveyor belt,etc. can be used but must be included in the sketch.
9) Extra materials that the school does not have, or can not get will have to be supplied by the student.
10) Evaluation will be based on the requirements on the back; self and group evaluation; and teacher evaluation

Special Instructions: Any extra materials that you bring will be returned after grading and contract completion.

Student Signature

_____

Instructor Signature

_____

Date_____

PROJECT PLANNING SHEET

This form must be carefully filled out and OK'D before starting.

Name_____ Date_____

Type of Project_____ Source of idea_____

_____

Draw a freehand sketch of what the finished project will look like.
Please include all <u>important</u> construction details & dimensions.

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Estimated time to Complete_____ OK

Actual Time_____

WIND CONVERTER
PROJECT REQUIREMENTS

The contract will be considered complete and graded by the following requirements. Circle the number under this student evaluation which you think is fair for a grade(5 is excellent and 1 is not so good)

5-4-3-2-1-0	Was the wind converter completed on or before time it was due, which was agreed on by both the group and Instructor
5-0	Was the construction done in class and open lab with the materials available and materials brought in?
5-0	Was a sketch turned in ½ the time or before the completion date?
5-4-3-2-1-0	How detailed and good was the sketch?
5---3---0	Did all the members of the group take part in planning and construction.
5-0	Was the total structure 3 feet in height and 2X2 feet square or under?
5-0	Does the converter change wind into a useful form of energy?
5-4-3-2-1-0	How well does the wind converter work?
5-0	Can you use all the blades of your group either together or seperately?(can you interchange them?)
5---3---1	How original was your idea?
5-4-3-2-1-0	How well was your group's 5 minute presentation of your converter?
5-0	Were all individual grades and group grades turned in when the project was due?

How would you grade yourself and the others in your group on the project? In the Blanks place the names of your group. Then in the first set of grades, circle what grade you would give individuals in the construction. In the second set of grades, grade on how they did in the presentation

A-B-C-D-F_____A-B-C-D-F; A-B-C-D-F_____A-B-C-D-F

A-B-C-D-F_____A-B-C-D-F; A-B-C-D-F YOURSELF_____A-B-C-D-F

CONTRACTED LEARNING TASK

Shawano I.E.C.P.

NATURAL SOURCES: Water Power

Activity #1

Name_____

INDIVIDUALIZED INSTRUCTION

Power and Energy

Estimated Completion Time_____ Mods

Date Started_____
Date to Complete_____
Date Completed_____

Resource Materials: Metal shears; 6" diameter aluminum circle; straight edge; metal scribe; compass; electric drill and 8/32" drill bit; Erector set wheel shaft; and Instruction Sheet.

Student Activity: Listed is a clear-concise list of statements telling you the student what to do and how to do it for this unit of work.

1) Get all the materials needed from instructor.

2) Read over instruction sheet and plan to construct standard wheel..... OR

3) Design your own blade using the 6" disc. If other than disc is used, material must be supplied by the student.

4) Construct your wheel after instructor ok's planning sheet if you are designing your own blade.

5) Make sure blade is balanced, and smooth.

6) Mount wheel onto an Erector Set shaft.

7) Present to instructor for inspection.

8)

9) Evaluation will be based on quality of design; construction; and will be evaluated on how balanced it is when spun.

10)

Special Instructions:_____

_____

Student Signature

_____

Instructor Signature

_____

Date_____

WATERWHEEL BLADE
Instruction Sheet

I. Find the Center of the disc.

A. There are many ways of doing this.

B. Here is one way of doing it:

1. Place a 3" board on its edge.

2. Place the disc on edge next to the board.

3. Scribe a line acrossed the disc like in figure.

4. Rotate disc about 90° and repeat #3, (like figure)

5. Repeat #4(should look like figure.)

6. Repeat #4 again.(should look like figure)

7. Draw diagnols through opposite corners.(box need not be square).

8. Where the diagnols meet is the center.

II. Draw a small circle out from the center.

A. This will be the end point of your blades.

B. Make sure the circle is round.

III. Scribe lines through the center of the blade.

A. Make lines like cutting a pie.

B. You will cut where these lines are, so read IV. first.

IV. Make cuts into the center with metal shears.

A. Make as many cuts as you want blades, but only to outside circle.

B. The more blades you make, the smaller the blades will be.

V. Drill 3/32" hole into the center of the disc.

VI. Twist the blades at right angles with the original disc.

VII. Mount wheel on Erectorset shaft.

VIII. Present blade to instructor for inspection.

A. Make sure blade is balanced.

B. Also make sure it is fairly uniform in shape.

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PROJECT PLANNING SHEET

This form must be carefully filled out and OK'D before starting.

Name_____ Date_____

Type of Project_____ Source of idea_____

Draw a freehand sketch of what the finished project will look like. Please include all <u>important</u> construction details & dimensions.

Estimated time to Complete_____ OK

Actual Time_____

CONTRACTED LEARNING TASK

Shawano I.E.C.P.

ELECTRICITY TRANSMISSION: Through Space and Solids
(Razor Blade Radio)

Name_____

INDIVIDUALIZED INSTRUCTION

Power and Energy

Estimated Completion Time_____ Mods

Date Started_____
Date to Complete_____
Date Completed_____

Resource Materials: #24 Wire; ¼"Wood Screws; 2"x6"x¼" Plywood; 4"x6"x¼" Plywood; 3/4" Finsshing Nails; Sand Paper; Paper Clips; Double Edge Razor Blade*; Pencil Lead*; Insulated Wire; Earphones*; Solder lug;Solder and Soldering Tools

Student Activity: Listed is a clear-concise list of statements telling you the student what to do and how to do it for this unit of work.

1) Bring materials that are marked with an * from home.

2) Get all other materials from your Instructor.

3) Follow your instruction sheet on this project completely.

4) Construct the project from the parts in #1 and #2.

5) Set up with the Ham Radio Antenna and the LAB VOLT ground connection.

6) Test unit out on your own. Does it work?

7) Evaluation will be based on the form on the back of this Contract.

8)

9) Take time now to look at what is required on the back of this Contract.

10)

Special Instructions: All soldering will be done on soldering board while WEARING SAFETY GLASSES!!!

Student Signature

Instructor Signature

Date_____

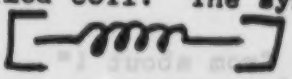
RAZOR BLADE RADIO
Instruction Guide

___ 1. Wrap 125 turns of small wire(#24) around a 2"x6"x¾" piece of Plywood.

A. Start on the top of the left hand side as shown in the the diagram below. Going clockwise, circle the wood and return back to the starting place. This gives you one complete turn.--You only have 124 more to go.

B. Make sure the turns do not over lap each other. They must lay side by side of each other.

C. You should finish on the same side you started wrapping. Tape the ends of the wire temporarily so they will not unwrap.

D. You new have a fixed coil. The symbol for a coil is shown like this: 

___ 2. Nail the coil to one end of the board as shown in the full page diagram located on the next page.

A. Leave the nail heads about 1/8"to1/4" above the surface. We will use them as solder lugs.

B. Twist the ends of the coil around both nails and solder.

___ 3. Sand the enamel off the top of the coil so that the bare wire shows.

A. Make sure not to sand completely through the wire.

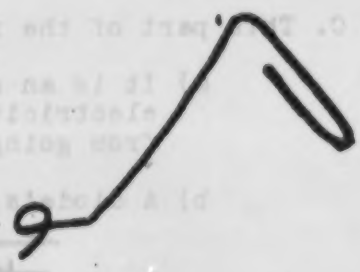
B. Sand gently as to not cross the wires.

___ 4. Bend a paper clip into the shape as shown in the figure below.

___ 5. Mount the paper clip like it is shown on the full page diagram with a ¾" wood screw.

A. Make sure the loop of the clip touches the wire.

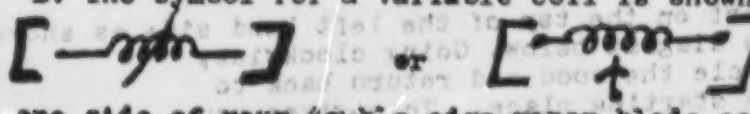
B. Also center the loop so it will pivot or swing across the sanded wire.



____ 6. Connect a wire around the wood screw holding down the paper clip. Retighten it back down.

A. You now have a variable coil where by moving the paper clip, you change the size of the coil.

B. The symbol for a variable coil is shown like this:



____ 7. Sand <u>one side</u> of your double edge razor blade completely clean.

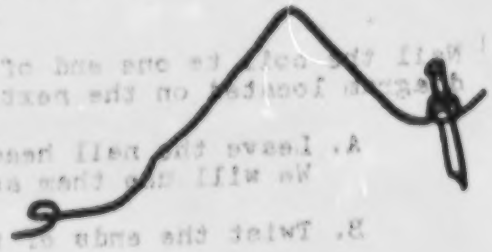
A. <u>Do not</u> sand the other side of the blade!!

B. Solder a wire to the sanded side of the blade.

____ 8. Mount the razor blade sanded side down using a $\frac{1}{4}$" wood screw. The location of this blade can be shown in the full page diagram before this sheet.

____ 9. Take another paper clip and bend it into shape as shown in the figure below:

____ 10. Remove the wood from about 1" of pencil lead from a pencil.



A. Graphite breaks very easily--do it carefully!

B. <u>Be sure</u> to <u>clean up</u> your <u>mess</u> afterwards.

____ 11. Wrap the long end of the paper clip around the lead fairly tightly.

____ 12. Mount the other end into the board next to the razor blade . and attach the wire onto the woodscrew.

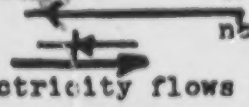
A. The pencil lead has to touch on the blade.

B. There should be enough spring in the paper clip to hold the lead tightly on the razor blade.

C. This part of the radio is called the diode.

a) It is an electrical one way street. It allows electricity to flow one direction but stops it from going the other way.

b) A diode's symbol is shown like this:



c) To tell which end is which with your diode, picture the diode and schematic symbol this way:

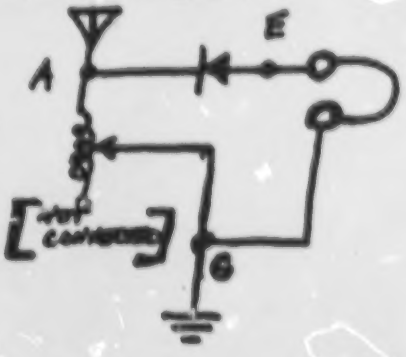
____ 13. Mount a 3 prong solder lug with a ½" wood screw as in the full diagram page found on page #2 of these instructions.

____ 14. Connect all the wires according to the schematic diagram:

A. Read the schematic diagram like a road map.

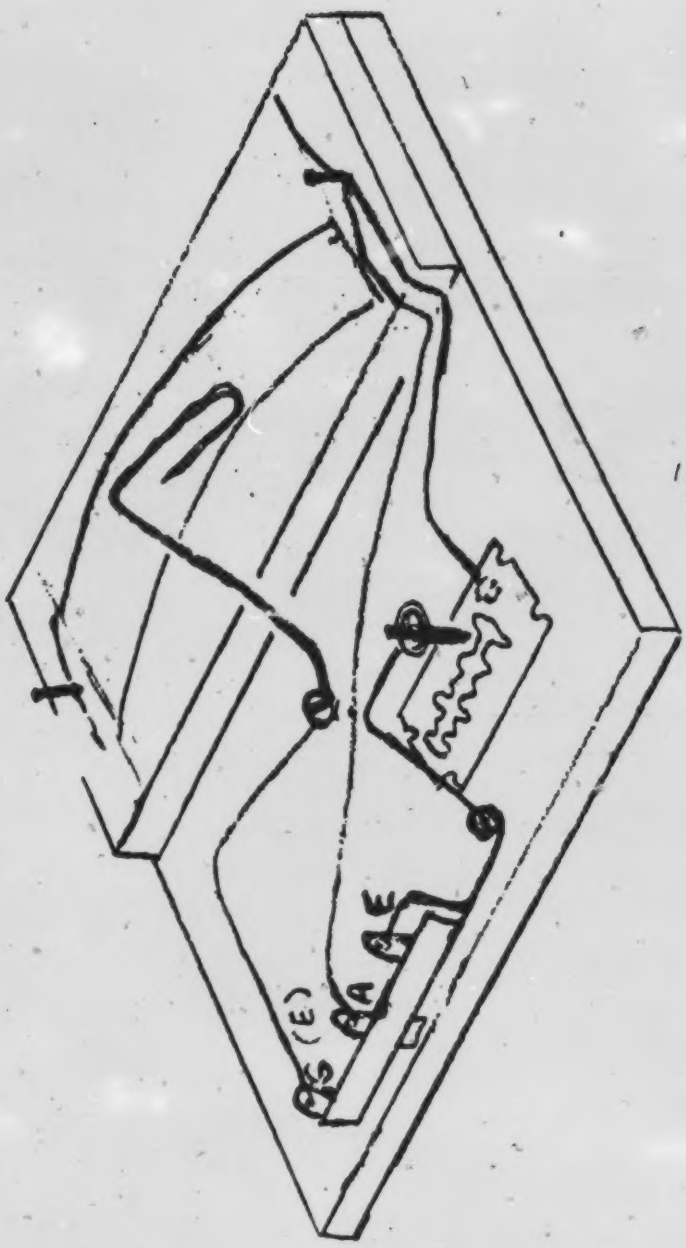
B. If you have trouble with the other symbols, look on pages 23-6 in Gerrish workbook.

C. Hint: Label on solder lug
A for Antenna
G for Ground
E for Earphone
(one earphone is on ground)



____ 15. Once your project is complete, use the Ham Radio antenna and ground connection from the LAB VOLT station to test your radio out.

____ 16. Evaluation will be based on the following evaluation form presented on the back of your contract.



150

TEACHER ACTIVITIES

Included in the activities section are a variety of teacher activities such as suggested field trips, special speaker suggestions, unique lectures, teaching hints and group activities related to power and energy.

concept: IV - Energy availability will affect future life styles and cultural conditions.

future

objective: D - The student will compare the life styles of a relatively energy independent household to one which depends largely upon centralized energy production facilities.

activities

1. Invite people who attempt an independent rural existence (counter-culture commune members are sometimes a good choice) to tell your class about their life style in relationship to energy consumption. The students, working in groups, could construct lists of changes in their life style that would save energy, then check those that would not substantially detract from the "quality of their living". They might commit themselves to several of these, then report their success, or lack of it, back to their class members periodically.

2. Collect pictures of households, both modern and historic, and compare the energy uses of each. Suggest ways the historic households could have been more energy efficient.

3. Draw a mural depicting differences in energy consumption practices now and 100 years ago.

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Vahon V. Bosmajian

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

concept: II - Most specific forms of energy originated with the sun.

sources

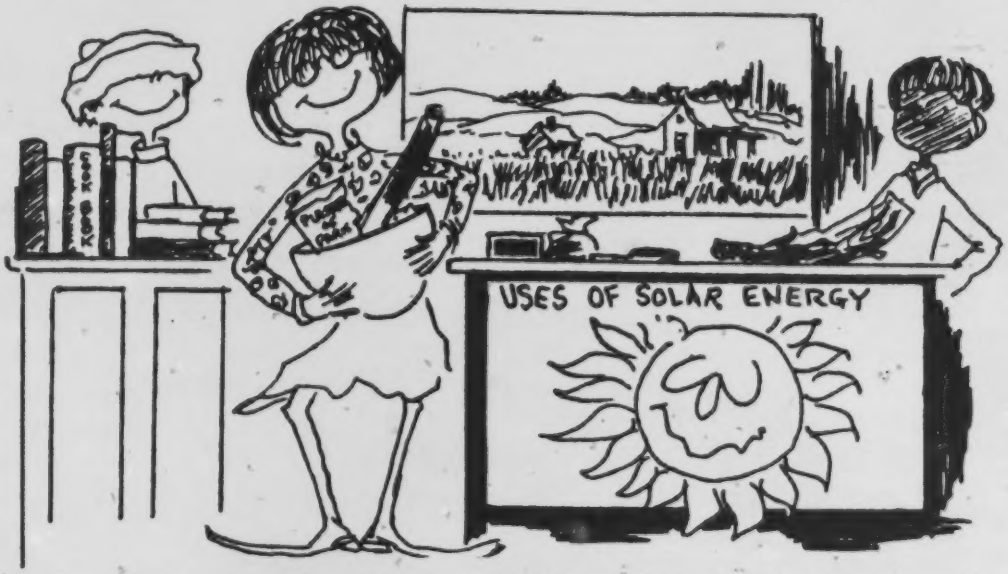
objective: G - The student will understand that the sun can be used directly by humans.

activities

1. Build a solar furnace made of plaster of paris and aluminum foil in a parabolic shape, with the heat collector at the focal point of the parabola. Use the collector to bring water to a boil. Boil some eggs for snacks.

2. Using a soft piece of pine or fir with a magnifying glass to collect the sun's rays, sketch a picture. (Watch out for villainous children with pyromaniac tendencies and sadistic impulses in their interaction with others.)

3. Build a solar furnace made of plaster of paris and aluminum foil in a parabolic shape, with the heat collector at the focal point of the parabola. Measure and log temperature differences at different hours of the day under different atmospheric conditions.



4. After researching the agricultural practices in the wheat country of Eastern Oregon and Washington, write an essay evaluating the energy sources used to farm in this area.

5. In a county or city library look for old cookbooks. Look up old ways of making preserves from strawberries or other berries, using direct solar energy. Find out if these methods were used in all areas or only in specific parts of the United States. Why the variation?

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concept: V. - High grade (concentrated) energy sources occur in relatively small amounts, and take relatively smaller amounts of "outside" energy to find and recover.

sources

objective: E -- New technologies will be used to mine or recover energy sources.

activities

1. Prepare individual diagrams with descriptive materials of how nuclear explosives may be used by ERDA to:
   a. Recover oil from oil shale in place without mining such as ERDA's Project Bronco.
   b. Prepare underground storage cavities for oil and natural gas.
   c. Stimulate the natural gas flow from sandstone deposits in states such as Colorado (Project Rulison).
   d. Compare the environmental impact of obtaining oil from oil shale that is mined and processed for oil extraction above ground versus recovery of the oil in place.
2. Find out what technological changes have occurred in coal mining, reporting about mining practices in 1850, 1900, 1950. What changes would you predict for 2000? 2050?
3. Compare oil-field reactions to natural gas at current times with those of 50 years ago (or 5 years ago in some fields). What new technologies have permitted improved world-wide distribution of natural gas?
4. Secure necessary components, mount and operate a solar cell.
5. Using the New York Times Index identify and explain all newly devised technological devices which can be used to enhance energy production that were discussed in the past year.
6. Visit a home in your area that has installed a solar energy collector and interview the architect that designed the system.
7. Using the information gained above, design a simple collector system that could be used in your school or home.
8. Make a methane generator and burn the methane produced like a gas flame from a gas jet.

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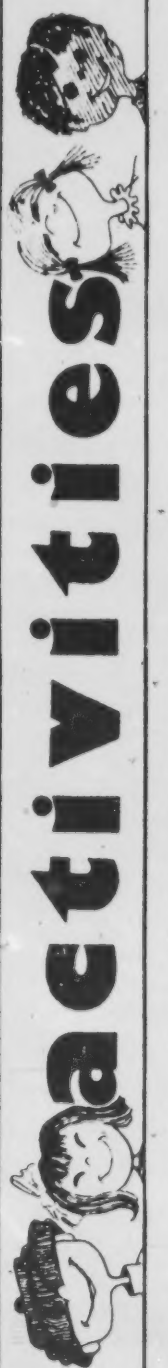
concept: V - Every decision made involving energy affects standards of living.

uses

objective: F - The student will know how social pressures to have things and use energy are created.



activities

1. Interview your parents concerning who makes the decisions about the purchase of major electric appliances. Ask what influences their selection of brand, size, and model. Ask whether the amount of electricity required is considered.

2. List the electrical appliances in your home in the order of their importance. List separately the ones you feel could be eliminated without lowering this "quality of existence."

3. Analyze television commercials for one week to determine procedures used to influence people to purchase advertised items. Do the same for magazines, newspapers, and billboards. Are the items shown necessary or desirable to own?

4. List ten things for which man now uses labor-saving devices that he once did for himself. Speculate on how the need to own an electric toothbrush was created.

5. Write an essay on why it is important or unimportant that your family "keep up with the Joneses," and show how energy contributes to this pressure.

6. Design a product and mount an advertising campaign designed to create a "need" for the product.

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Iowa Energy Policy Council
Iowa Dept. of Public Inst.

NON-RENEWABLE ENERGY SOURCES

Scrambled Word Puzzle

The following scrambled words are names for non-renewable energy sources. Unscramble them and write the words in the blanks.

1. ACLO _____
2. SAG LAURNTA _____
3. LECRTEITYIC _____
4. LIO _____
5. MTEPRUOEL _____
6. LISFOS SEFUL _____

ENERGY PUZZLE

C	O	N	S	E	R	V	A	T	I	O	N
U	S	R	E	C	Y	C	L	E	T	R	G
T	K	I	L	O	W	A	T	T	S	B	E
E	P	O	E	F	A	D	M	H	C	L	O
R	N	A	C	G	T	H	S	E	D	I	T
A	U	E	T	H	E	S	W	R	Q	G	H
T	C	V	R	V	R	S	D	M	F	H	E
I	L	N	I	G	C	F	O	A	A	T	R
O	E	Q	C	T	Y	O	R	L	O	N	M
N	A	M	I	W	U	S	U	N	A	C	A
I	R	E	T	E	X	S	S	J	K	R	L
N	L	P	Y	A	C	I	P	S	M	I	T
G	O	K	I	R	O	L	A	F	A	S	E
S	H	O	R	T	A	G	E	L	N	I	R
B	V	I	U	H	L	Z	B	O	U	S	N
L	G	L	D	R	C	S	F	W	R	L	A
P	E	N	V	I	R	O	N	M	E	N	T
V	I	H	F	V	H	U	R	U	D	O	I
W	O	O	D	E	J	R	F	P	E	M	V
J	O	Y	K	R	O	C	E	A	N	Q	E
D	S	Z	M	O	H	E	A	T	I	G	C

Find these words in the puzzle.

sun
crisis
wood
coal
gas
oil
geothermal
tides
wind
electricity
source
kilowatt
water
energy
solar
nuclear
thermal
recycle
environment
rationing
shortage
fuel
conservation
fossil
flow
manure
earth
heat
light
alternative
food
river
man
ocean

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Iowa Dept. of Public Inst.

MY WEEKEND DIARY

In your diary, tell what you have done each day during the weekend. Remember, there is no bus, no car transportation, no heating or air conditioning, no TV, no phone. A diary is for keeping record of things you have done and feelings you have.

Friday

Saturday

Sunday

WHAT HAPPENED

You have just come home from school. You turn on the radio, but nothing happens. You check the cord. No problem there, it's plugged in. Then you notice the clock has stopped. You check around the house and discover there is no electricity. A blackout. It has affected the whole neighborhood, the whole city. There is no indication of when the power will be restored. It may be off for days.

(Write a story describing what happened to cause it and how people reacted. What was life like?)

ACTIVITIES

"Environmental Experiments".....from Edison

Thomas Alva Edison Foundation
2000 Second Avenue
Detroit, Michigan 48226

32 page paperback listing 12 activities & experiments suitable for Jr. high energy or science programs

Local building inspector: an excellent prospect for a guest speaker as he is familiar with state energy codes, heat loss calculations, heating and cooling requirements and restrictions etc. - contact local people

Local heating, air conditioning, and electricians: This person probably has an extensive background in heating, air conditioning, solar heat, etc. - contact local people

Teachers: start a file folder or have students start one

Visit Local power plants: see electricity being produced and backup systems

Iowa Energy Policy Council
Iowa Dept. of Public Inst.

READING AN ELECTRIC METER

READING = 13488

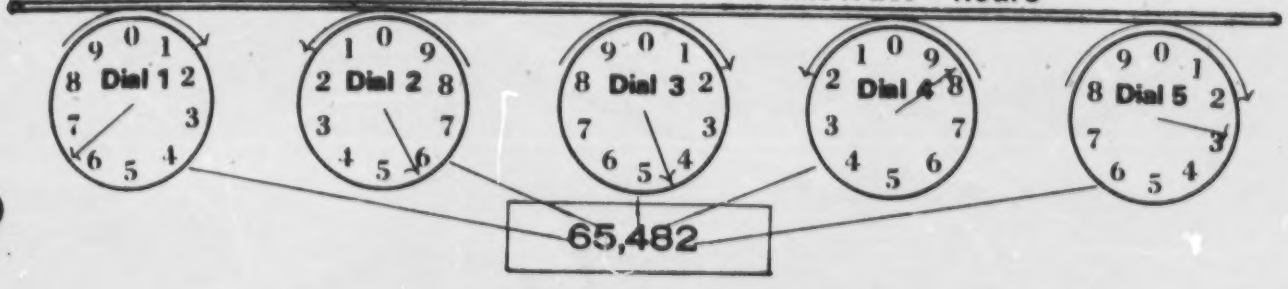
READING = 35721

READING = 66190

Monday morning meter reads 13478

Tuesday morning meter reads 13488

How much has home consumed? 13488
-13478
10 kilowatt - hours



Which is the better

INSULATOR?

Things you need: four or five fruit juice cans, ice cubes, magic marker, items for insulation (as indicated below)

Take four or five fruit juice cans. Place an ice cube in each can and place a number on each can.

Can #1 - no insulating material (leave as is)
Can #2 - paint outside of can black
Can #3 - use styrofoam packaging material
Can #4 - use newspapers, the same thickness as the styrofoam
Can #5 - choose one of the other insulating materials from the box

Place all cans either in the sun or in the shade. Check the ice cubes every 15 minutes until the first ice cube has melted. Continue to check until all ice cubes are melted. Record the time it takes to melt each ice cube.

	Time
Can #1	____
Can #2	____
Can #3	____
Can #4	____
Can #5	____

Insulation used _____

LESSON 1

DEFINITIONS OF TERMS

DESCRIPTION OF LESSON

This lesson is designed to acquaint students with terms common to the areas of Power & Energy. (A printed sheet of these definitions will be handed to each student at the beginning of the course.)

BEHAVIORAL OBJECTIVES

The student will be able:

1. To define all terms and to display correct usage of the terms.

TIME SCHEDULE

5 minutes	Description of Lesson
10 minutes	Lecture and Class Discussion
40 minutes	Laboratory Activity

CONTENT OUTLINE

I. Terms and definitions

LECTURE AND CLASS DISCUSSION

1. Energy - the ability to do work
2. Work - applying a force to cause motion (force x distance)
3. Horsepower - (rate of doing work) $\frac{\text{work}}{\text{time in seconds} \times 550}$

   or $\frac{\text{work}}{\text{time in minutes} \times 33{,}000}$
4. Power - rate of doing work
5. Prime mover - any device that converts the power of human and animal muscle, running water, wind, heat, or electricity into a more usable form of energy
6. Machine - an assembly of parts that transmits forces, motion, and energy one to another in a predetermined manner

7. Control - to exercise restraining or directing influence over working forces

8. Friction - the resistance to relative motion between two bodies in contact

9. Heat - a form of energy into which mechanical energy may be converted

10. Pressure - the ratio of force to area

11. Efficiency - the performance of a machine judged with respect to its theoretical maximum performance

12. Torque - a turning effort or that which tends to cause rotation in a body; units are foot-pounds, inch-pounds, etc.

13. Force - that which causes motion or displacement

14. Displacement - the distance an object moves under the action of a force

15. Vacuum - a space absolutely devoid of matter

16. System - a group of parts working together to perform some function

17. Transmission - the relaying of a working force

18. Conversion - the process of changing energy from one form to another

19. Mechanical energy - work produced by machines or tools

20. Fluid energy - liquids or gases put under pressure to create motion or work

21. Electrical energy - quantity of electron flow in a given time

22. Mechanical advantage - the advantage gained by the use of a mechanism in transmitting force

23. Inertia - that force which tends to keep a stationary object from being moved, and tends to keep a moving object in motion

24. Cycle - a course or series of events or operations that recur regularly

STUDENT ACTIVITIES

1. Word Matrix Game

2. P and E Game

3. Crossword Puzzle

4. Distribute selected terms to students. Have them write down examples of where the term is used or a device that uses the principle.

HOMEWORK

Work the crossword puzzle and hand it in the next day.

INFORMATION SHEET FOR LESSON 1

DEFINITIONS OF TERMS

1. Energy - the ability to do work

2. Work - applying a force to cause motion (force x distance)

3. Horsepower - (rate of doing work) $\frac{\text{work}}{\text{time in seconds} \times 550}$ or

$$\frac{\text{work}}{\text{time in minutes} \times 33{,}000}$$

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Information Sheet for Lesson 1

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24. Cycle - a course or series of events or operations that recur regularly

STUDENT ACTIVITY FOR LESSON 1

Name_____
Hr._____

WORD MATRIX GAME

E G A T N A V D A B Y M J E C R O F L P
N D P O E X O T D T C K R O W V M Q A U
I H O R S E P O W E R S N V R N L H L K
H W W F N L R R N S W V R A H L G Y T C
C V E E T C I Q T A E H C C O N T R O L
A G R E H Y M U P R E S S U R E B J H O
M G X U F C E E S B Z D I U L F U H I Z
Y T R A N S M I S S I O N M E T S Y S L
L A K G V N O I T C I R F G N O L R S T
P Y Z Q A N V D I S P L A C E M E N T U
X L E O E L E C T R I C A L K U T K Y G
W Z N I N E R T I A E F F I C I E N C Y

Energy
Inertia
Efficiency
Electrical
Displacement
Friction
System
Transmission
Machine
Advantage
Cycle
Power
Work
Horsepower
Force
Control
Pressure
Heat
Conversion
Fluid
Torque
Vacuum
Prime Mover

INSTRUCTIONS:

Find the above listed words throughout the word matrix. They may be found by reading forward, backward, up, down, or diagonally.

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STUDENT ACTIVITY FOR LESSON 1

INSTRUCTIONS FOR THE P AND E GAME

1. Students will list the terms at random in the 24 boxes provided.
2. The instructor then reads the definitions of the terms listed, and students will make a mark in the box which has the corresponding term.
3. A student is declared the winner when he has marked all boxes across, down, or diagonally in a straight line.
4. The instructor then checks the winner with the definitions read.

NAME_____

P AND E GAME

Mechanical Energy	Fluid Energy	Mechanical Advantage	Flectrical Energy	Transmission
Work	Power	Heat	Displacement	Conversion
Machine	Control	Energy	Force	Friction
Cycle	Torque	Horsepower	Prime Mover	Efficiency
System	Inertia		Pressure	Vacuum

P	a	n	d	E
		FREE		

STUDENT ACTIVITY FOR LESSON 1

CROSSWORD PUZZLE CLUES

ACROSS

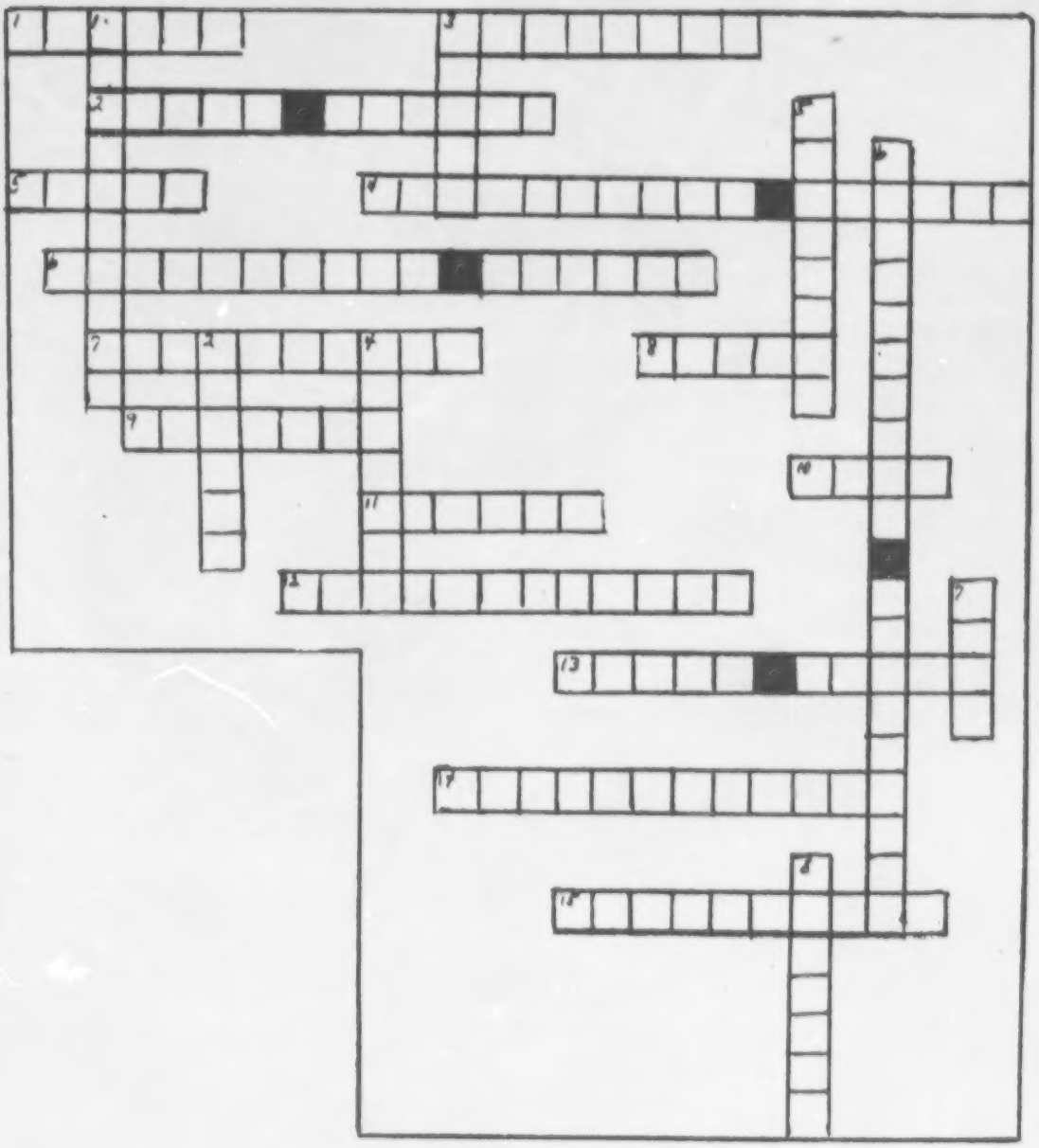
1. The ability to do work
2. Substances put under pressure to create motion or work
3. The resistance to relative motion between two bodies in contact
4. Quantity of electron flow used to do work
5. A course or series of events or operations that recur regularly
6. Work produced by machines or tools
7. The process of changing energy from one form to another
8. The rate of doing work
9. An assembly of parts that transmits forces, motion, and energy one to another in a predetermined manner
10. A form of energy into which mechanical energy may be converted
11. Units of measurement are inch-pounds, foot-pounds, etc.
12. The relaying of a working force
13. Devices that convert power of human, animal muscle, etc., into usable forms of energy
14. The distance an object moves under the action of a force
15. $\frac{\text{work}}{\text{time in seconds} \times 550}$

DOWN

1. The performance of a machine judged with respect to its theoretical maximum performance
2. A space absolutely devoid of matter
3. That which causes motion or displacement
4. Forces which tend to keep a stationary object from being moved and tend to keep a moving object in motion
5. The ratio of force to area
6. The advantage gained by the use of a mechanism in transmitting force
7. Applying a force to cause motion
8. To exercise restraining or directing influence over working forces

STUDENT ACTIVITY FOR LESSON 1

CROSSWORD PUZZLE



STUDENT ACTIVITY FOR LESSON 1

KEY TO THE CROSSWORD PUZZLE

ACROSS

1. Energy
2. Fluid Energy
3. Friction
4. Electrical Energy
5. Cycle
6. Mechanical Energy
7. Conversion
8. Power
9. Machine
10. Heat
11. Torque
12. Transmission
13. Prime Mover
14. Displacement
15. Horsepower

DOWN

1. Efficiency
2. Vacuum
3. Force
4. Inertia
5. Pressure
6. Mechanical Advantage
7. Work
8. Control

RESOURCES:

Ready access to securing resources in developing an industrial education program are invalauble.

The resources included in the following section of the handbook include guides, texts, journals, educational games and simulations, companies and people.

The resources that are included are mot meant to be all inclusive but rather were selected to get the curriculum developer off and running.

RESOURCES

Included in the "resources" section are the following (as they relate to power and energy):

1. People (Knowledgable resource contacts)
2. Companies (venders, suppliers, etc.)
3. AV (films, transparencies)
4. Booklets (catalogs, pamphlets, etc.)
5. Texts (books, etc.)
6. Curriculum Materials (state guides, etc.)

FILM LIST
16 MM MOVIES

NATIONAL INFORMATION CENTER FOR EDUCATIONAL MEDIA
University of Southern California
N.I.C.E.M.
University Park
Los Angeles, CA 90007

ENERGETICALLY YOURS - optical sound - 1958 - In a humorous manner, man is shown in his unrelenting search for energy sources. Animation is used to trace man from the cave to his present exploits with atoms.

ENERGETICS OF LIFE - optical sound - Shows where the energy inside us comes from. Begins with concepts in energy transfer like free energy and entropy to show why some molecules have potential energy particularly the atp molecule. Shows how energy transfer starts with energy from the sun, which is converted with the help of ATP into potential energy in molecules like glucose. From The Life Science Series.

ENERGY - optical sound - Presents Linus Pauling, a chemist, Gerald Wald, a biologist and Philip Morris, a physicist, discussing and debating the nature of energy, includes questions about what energy is and the use and misuse of energy.

ENERGY - optical sound - 1950 - Presents various types of energy such as a boy's muscle, a rubber band, air, steam, electricity and water. From The Primary Science Series.

ENERGY - optical sound - 1974 - Explores the subject of energy in human beings, animals, the elements and the earth. Shows how these different kinds of energy are harnessed and the ways in which they are used daily in home and industry. Points out that pollution is a result of excess use and barren devastation, a result of a lack of thoughtful conservation. From the Economics for Elementary Series.

NEERGY - optical sound - 1965 - Shows how man as an energy machine is inefficient. Describes three sources of energy - water, coal and oil, and demonstrates how they have given man more leisure.

ENERGY - optical sound - 1970 - A visual demonstration of power systems and the transformations of energy. Highlights the power systems of the past, present and future.

ENERGY - optical sound - 1956 - Both kinds of energy, potential and kinetic, are defined. How energy from the sun is changed to energy we can use, such as coal and food, and how energy is changed from one form to another, is explained. From The Junior Science Series.

ENERGY - optical sound - 1970 - Examines the interplay of forces by which different parts of matter affect each other's movements. Develops an awareness of the universal role played by energy in physical processes.

ENERGY - optical sound - 1965 - Traces the development of energy resources and demonstrates the contribution low-cost abundant petroleum energy has made to present high standards of living.

ENERGY - A CONVERSATION - optical sound - 1975 - Presents a conversation on the nature of energy between Dr. Linus Pauling, Dr. George Wald and Dr. Philip Morrison. Discusses the definition of energy, different forms of energy and sources of energy. From The Physical Science Today Series.

ENERGY - A FIRST FILM - optical sound - 1971 - Discusses the value of energy and how it changes form. Explains how energy, no matter what form or transformation it undergoes, originates from the sun.

ENERGY - A MATTER OF CHOICE - optical sound - 1973 - Gives an overview of the energy sources man depends on. Studies the causes of and the responses to the energy crisis that began during the early 1970's.

ENERGY - ABILITY TO DO WORK - optical sound - 1968 - Presents a basic study of energy, its forms and kinds for elementary grades.

ENERGY - CAN'T DO WITHOUT IT - optical sound - 1974 - Examines a variety of sources of energy in the world today, including electrical energy, coal, oil and other fossil fuesl. Shows the great importance of energy in modern society.

ENERGY - CHOICES, OPTIONS, DECISIONS - optical sound - 1974 - Examines the search for new means of meeting America's continuing energy challenges. Explores energy sources and conservation, research and development that will serve the public good and promote the national interest. From The Screen News Digest Series, Volume 17, Issue 4.

ENERGY - LESS IS MORE - optical sound - 1973 - Investigates the need for slowing the growth of energy consumption and shows ways in which this can be done. From The Energy Series.

ENERGY - NEW SOURCES - optical sound - 1974 - Examines the potential and limits of new technologies, including solar, fusion and geothermal. Presents an argument for developing a variety of options. Stresses societies' need to develop ways of using less energy. From The Energy Series No. 3.

ENERGY - THE DILEMMA - optical sound - 1974 - Discusses past, present and future energy growth patterns. Explores problems of supply and demand, depletion of fossil fuels, our dependency and economic and social problems. Stresses societies' need to develop ways of using less energy. From the Energy Series, No. 1.

ENERGY - THE NUCLEAR ALTERNATIVE - optical sound - 1974 - Explores fission power, how it works and the controversies over safety and radioactive waste. Stresses societies' need to develop ways of using less energy. From the Energy Series, No. 2.

ENERGY - TOWARD THE AGE OF ABUNDANCE - optical sound - 1975 - Notes awareness of the energy shortage. Suggests one powerful source which is only beginning to be utilized, the sun. Explains how solar energy can serve the world through an orbiting satellite of solar cells which can follow the path of the sun and receive power 24 hours a day. Presents Dr. Peter Glasser and Robert Hallman examining the huge benefits and grim dangers of new sources of energy. From The Coping With Tomorrow Series.

ENERGY - TOWARDS THE AGE OF ABUNDANCE - optical sound - 1975 - Examines the nuclear fission plant as a possible replacement for the traditional energy source of coal. Interviews people who live close to a large nuclear station in New York State, pointing out their objections to the plant. Discusses the harnessing of the fusion reaction and the use of tidal power and solar energy as possible solutions to the energy crisis. From The Towards The Year 2000 Series.

ENERGY ABSORPTION PROCESS EMPLOYING FRANGIBLE METAL, AN - optical sound - 1964 - Describes the frangible tube shock abosrber which relies on the principle of fragmentation. Shows its development for use as a landing impact absorber for spacecraft.

ENERGY AND ALL THAT - optical sound - 1973 - Discusses and explains the complexity of America's energy situation.

ENERGY AND ITS FORMS - optical sound - 1961 - Explains the basic concept of energy. Shows that energy is changed from one form to another to do work. Tells how plants covert the energy of the sun to chemical energy to provide food and fuel.

ENERGY AND ITS TRANSFORMATIONS - optical sound - 1933 - Potential, kinetic, and radiant energy, as manifested in mechanical, chemical and thermal form, is illustrated. The principle of conservation of energy and the concepts of power and work are demonstrated in experiments.

ENERGY AND LIFE - optical sound - 1968 - Presents basic physical laws. Discusses transfer of energy among living organisms and develops the basic biological concepts of ectrophy. Shows numerous examples from less industrial count ries and draws conclusions about the food, fuel and energy relationship. From The Science of Life Series.

ENERGY AND LIVING THINGS - optical sound - 1972 - Defines energy and living matter and demonstrates how they are essential to all forms of life. Traces solar energy through plants to herbivores, carnivores, decomposers and to fossil fuels. Discusses the energy requirements of man and investigates his use of the remaining fuel energy reserves.

ENERGY AND MAN - optical sound - 1968 - Explains that energy has many forms and sources and that one form of energy can be transformed into another.

ENERGY AND MATTER - optical sound - 1966 - Explains what energy is and demonstrates the relationship between the various forms of energy and between energy and matter.

ENERGY AND MODELS - optical sound - 1972 - A teacher training film which presents classroom experiences of children and teachers using fifth- and sixth-grade level science curriculum improvement study materials.

ENERGY AND MOMENTUM - LABORATORY - optical sound - 1957 - Illustrates measurement of the forces involved in driving a nail into a block of wood. From The Introductory Physics - Mechanics Series.

ENERGY AND POWER - optical sound - 1957 - Uses mechanical models to demonstrate principles of kinetic energy and power. From The Introductory Physics - Mechanics Series.

ENERGY AND POWER - A FIRST LOOK - optical sound - 1962 - Outlines, from the days of the caveman to the present, many ways in which man harnesses energy and increases his capacity to do work by utilizing the potential energy found in wood, wind and running water.

ENERGY AND REACTION - optical sound - 1961 - Shows the relationship between energy and chemical reactions. Relates this phenomenon to fundamental concepts, such as chemical bonding, activational energy and rate of reaction. From The Basic Chemistry Series.

ENERGY AND WORK - optical sound - 1961 - Defines energy, potential energy and kinetic energy. Shows how energy is expanded and stored and how energy can be changed from one form to another.

ENERGY AND WORK - optical sound - 1960 - Introduces work as a useful measure of kinetic energy transfer in various interactions. From the PSSC Physics Films Series.

ENERGY CHALLENGE, THE - optical sound - 1973 - Discusses the causes and effects of the energy shortage, problems and opportunities and various plans and proposals. From The Screen News Digest Series Volume 16, Issue 1.

ENERGY CRISIS - optical sound - 1972 - Reviews the different energy sources and indicates the length of time we may be able to depend on them. Shows the possibility of solutions and developments which may some day provide unlimited power to meet our needs.

ENERGY CRISIS SERIES - COAL - optical sound - Discusses coal which is the most plentiful fossil fuel, yet the dirtiest and the most destructive to mine.

ENERGY CRISIS SERIES - ENVIRONMENT - optical sound - Introduces the study of energy as it relates to the central issues of man's relationship with the world in which he lives.

ENERGY CRISIS SERIES - FUTURE FUELS - optical sound - Contrasts the need for new available energy sources with the fact that nobody seems to be looking very hard.

ENERGY CRISIS - A SERIES - Describes specific aspects of the energy problem. Coal - The Environment - Future Fuels - Natural Gas - Oil in the Middle East - Oil in the United States - Power

ENERGY CRISIS, THE - optical sound - 1973 - Details basic facts about nuclear power generation, telling what it is, how it works and how it can help to close America's energy gap. Presents the controversy among experts about the safety of nuclear plants.

ENERGY CRISIS, THE - AMERICAN SOLUTIONS, PART 1 - optical sound - Deals with the problem of oil on which the American economy has been built.

ENERGY CRISIS, THE - AMERICAN SOLUTIONS, PART 2 - optical sound - Deals with the resource shortages that will make the United States dependent on foreign suppliers. Explores the question of how America can meet its energy needs in 1980 and beyond.

ENERGY CYCLES IN THE CELL - optical sound - 1967 - Shortened version of the 1959 motion picture 'CELL RESPIRATION'. Describes respiration as the power producing part of cell metabolism. Explains the function of ATP molecules in cell respiration and relates this to cell nutrition and synthesis. From The Our Living World Series.

ENERGY DOES WORK - optical sound - 1961 - Billy learns that when he is playing, he is doing work. He discovers that work is done whenever something is moved, that energy causes things to move and that energy can be stored.

ENERGY FOODS - optical sound - 1952 - Shows the part played in nutrition by the carbohydrates and fats.

ENERGY FOR EUROPE - optical sound - 1957 - Presents a discussion of the problem of meeting the demands of Western Europe over the next two decades for energy in the form of coal, oil, hydroelectricity and atomic power.

ENERGY FOR THE FUTURE - optical sound - 1974 - Examines the current dependence of industrialized countries on dwindling supplies of natural fossil fuels. Shows how intensive research is now underway into new sources of energy, including processed coal, shale oil, geothermal heat, nuclear fission, wind energy and solar heat.

ENERGY FROM MATTER - optical sound - 1956 - Presents a brief account of the atomic theory and the structure of matter. Discusses the production and use of nuclear energy.

ENERGY FROM THE SUN - optical sound - 1955 - Animation shows how solar energy is transmitted through space and why the earth receives so small a fraction of it. In simple terms, the film illustrates how the fusion of hydrogen nuclei forms helium nuclei, and how some of the mass, which appears lost, is converted into energy.

ENERGY FROM THE SUN - optical sound - 1963 - Discusses facts about energy from the sun, such as hydrogen fusion as the source, green plants' need for radiant energy, the winds, and the water cycle. From The General Science Film Series.

ENERGY GAME, THE - optical sound - 1972 - Shows scientists discussing the energy shortage in the United States, and the role atomic power plants have played in the problem. From The Science 71 - A Report to the Nation Series.

ENERGY IN LIFE - optical sound - Concentrates on the basic physical laws of energy conversion from one species to another. Contrasts less industrialized nations with more industrialized nations and shows how they face the food-fuel crisis. Questions what the atomic age's conversion of energy will bring. From The Biology Series.

ENERGY IN NATURE - optical sound - 1970 - Explains that all of the energy reaching the earth originates from the sun and that a great energy cycle is produced, linking all natural processes on earth. Shows that the sun's energy causes plants to grow providing food which in turn becomes the 'FUEL' providing bodily energy. Pictures wind-powered generators and tidal barrages, powered by energy generated in the sea and atmosphere. From The Energy Series No. 4.

ENERGY IN ORBIT - optical sound - 1970 - Presents the meanings of potential and kinetic energy and describes the ways in which these forces affect a satellite's orbit. Shows how a satellite's orbit may be changed by using rocket thrusts to alter the satellite's energy. From The Space - The New Science, High School Level Series No. 2.

ENERGY IN OUR RIVERS - optical sound - 1948 - Demonstrates methods of harnessing rivers to provide electrical power, such as water wheels and modern hydro-electric turbines, animation and photography show dams and how their power is utilized.

ENERGY INTO WORK - optical sound - 1970 - Examines the efficiency of energy transformations from one form of energy to another, states that the total energy in the environment is constantly changing. Demonstrates the two kinds of energy, kinetic energy and stored energy. From The Energy Series No. 3.

ENERGY LOSSES AT PIPE JUNCTIONS - optical sound - 1959 - Illustrates that 90 degree junctions of tile used for agricultural field drainage are as satisfactory as 30 or 45 degree junctions of the lateral with the main.

ENERGY ON THE MOVE - optical sound - Presents the story of cooperative free enterprise industries and their part in the economy of Colorado and the nation.

ENERGY ON THE MOVE - optical sound - 1966 - The story of the natural gas industry - what natural gas is and how it is tapped and converted into energy, which has many uses in technology, manufacturing and other areas.

ENERGY PICTURE, THE - optical sound - 1959 - Tells the story of man's use of energy from earliest times to the present day, and of his constant search for new energy sources.

ENERGY RELATIONS - optical sound - 1961 - Explains the transfer and loss of biomass and energy from primary producers to herbivores and one or more levels of carnivores. Illustrates food chains and webs, introduces the trophic level concept and explains productivity. From The AIBS Modern Biology Film Series, Part 9, Ecology.

ENERGY RELEASE FROM FOOD - optical sound - 1946 - Uses animated diagrams to schematize the roles of nicotinic acid, thiamine and riboflavin in the energy exchanges of carbohydrate metabolsim as assisted by enzymes. Illustrates certain clinical deficiencies of the B-vitamin complex.

ENERGY SAVING KITCHEN - optical sound - 1956 - Pictures a model kitchen designed for urban or rural homemakers who must conserve energy because of illness or old age.

ENERGY SOURCES - A MATTER OF POLICY - optical sound - Asks where we have been and where we are going in our efforts to secure sufficient energy to meet constantly increasing demands. Considers America's possible independence from foreign sources and environmental safeguards. From The Energy Sources - A New Beginning Series.

ENERGY SOURCES - A NEW BEGINNING - A SERIES - Discusses various sources of energy, both old and new - Energy Sources - A Matter of Policy, Geothermal Power - The Great Furnace, Nuclear Energy - The Great Controversy, Nuclear Gas Stimulation - Tapping Our, Oil Shale - The Rock That Burns Sleeping Giant, The - Coal, Solar Power - The Giver of Life, Tar Sands - Future Fuel, Wind Power - The Great Revival.

ENERGY - HOW DOES IT WORK - filmstrip with rec/cas/script - See series title for descriptive statement. From The Energy And You Series.

ENERGY - IMPACT ON VALUES AND LIFESTYLES - filmstrip with record/cassette - Assesses the impact of more expensive energy and energy shortages on lifestyles, societal patterns and existing values. From The Current Affairs Filmstrip Series.

ENERGY - MAKING THINGS GO - filmstrip with rec/cas/script - 1975 - Explores the nature of energy and its different forms. From The Let's Find Out Series.

ENERGY - SOURCES AND MAN'S NEEDS - sound filmstrip - audio tape - 1974 - Explains the variety of energy sources available to man and the possible problems affecting our environment that arise from using certain energy sources. From The Ward's Solo-Learn System Series.

ENERGY - THE CARBOHYDRATES - sound filmstrip - audio tape - 1973 - Discusses the digestion, absorption and utilization of carbohydrates. Explains calorie and energy equations along with factors that increase and decrease calorie requirements. Includes food sources and lists of carbohydrates in the diet and examines four problems of excess carbohydrates intake. From The Nutrition Series.

ENERGY - THE KEY TO MAN'S GREATEST GOALS, GROUP 1 - A SERIES - Introduces the concept of energy and gives two sources of energy and how they are harnessed.

ENERGY - THE KEY TO MAN'S GREATEST GOALS, GROUP 2 - A SERIES - Explores six sources of energy and how they are harnessed. Examines the future of the energy question and how it will affect people.

ENERGY - TODAY AND TOMORROW - filmstrip - Highlights some of the facts associated with the problem of the decrease of world energy resources due to the increase of world population.

ENERGY - TODAY AND TOMORROW - filmstrip with cassette/script - See series title for descriptive statement. From The Concepts in Science Set 8 Series.

ENERGY - TRANSACTIONS IN TIME - filmstrip with record/cassette - 1974 - Encourages the consideration of different sources of energy, such as uranium, plutonium and heavy hydrogen. Weighs their relative efficiency against their danger and effects on the environment. From The Dimensions of Change Series.

ENERGY - USING IT WISELY - filmstrip with rec/cas/script - See series title for descriptive statement. From The Energy And You Series.

ENERGY - WHAT IS IT - filmstrip with rec/cas/script - See series title for descriptive statement. From The Energy And You Series.

ENERGY - WHAT LIES AHEAD - filmstrip with record/cassette - 1974 - Discusses energy, dealing primarily with prospects for the future and how these prospects will affect the population. Describes some of the experimentation being done today in the field of energy. From The Energy - The Key to Man's Greatest Goals, Group 2 Series.

ENERGY - WHERE DOES IT COME FROM - filmstrip with rec/cas/script - See series title for descriptive statement. From The Energy and You Series.

ENERGY - AND ENGINES - filmstrip with captions - 1957 - See series title for descriptive statement. From The Engines And Rockets Series.

ENERGY AND ENTHALPY IN CHEMICAL CHANGE - sound filmstrip - record - 1972 - Examines the various forms of energy with reference to physical examples. From The Biology - Secondary Science Series.

ENERGY AND ENTROPY - DRIVING FORCE OF A CHEMICAL REACTION - filmstrip with tape/script/cap - 1969 - Explains the role of energy and entropy changes in the determination of the spontaneity and direction of a chemical reaction. Illustrates measurement and calculation of Gibbs free-energy change.

ENERGY AND GROWTH - sound filmstrip - audio tape - Shows Joe and his friends as they catch a lizard, only to be faced with the problem of how to care for it. From The Nutrition - Food, Fuel And Energy Series.

ENERGY AND ITS COST TO OUR ENVIRONMENT - filmstrip with rec/cas/script - 1974 - See series title for descriptive statement. From The Energy And The Environment - How To Live On the Earth A Long Time Without Using It All Up Series.

ENERGY AND LIFE - filmstrip with captions - 1955 - See series title for descriptive statement. From The Principles of Biology, Set 1 Series.

ENERGY AND LIFE - sound filmstrip - audio tape - 1972 - Introduces the student to the basic requirements of all life, energy. From The Life - A Unique Phenomenon Series.

ENERGY AND MAN - A SERIES - Illustrates energy in its various forms. Describes the distinction between potential and kinetic energy, the conversion of other forms of energy to mechanical energy and the effects of mass and velocity.

ENERGY AND OUR ENVIRONMENT - MAN AND THE WORLD'S ENERGY - filmstrip with record/cassette - 1975 - Traces energy sources used by man from primitive times through the extraction and use of fossil fuels.

ENERGY AND OUR ENVIRONMENT - OUR GROWING USE OF ENERGY - filmstrip with record/cassette - 1975 - Examines how an increased use of energy by an increasing population has caused energy shortages and severe pollution.

ENERGY AND OUR ENVIRONMENT - THE FUTURE - filmstrip with record/cassette - 1975 - Investigates how developments in the utilization of solar and nuclear energy and energy-conserving lifestyles can reduce pollution.

ENERGY AND OUR ENVIRONMENT - WASTE AND POLLUTION - filmstrip with record/cassette - 1975 - Examines the functions and pollutants of energy conversion in heat engines and electricity generating plants.

ENERGY AND OUR FUTURE - filmstrip with rec/cas/script - 1975 - Considers the growing need for energy and for the development of new sources of energy other than fossil fuels, including fission and fusion and solar energy. From The Energy for Man Series.

ENERGY AND STATE RELATIONSHIPS - filmstrip - record - 1971 - Uses photographs, diagrams and experiments to show the relationships between energy and state. Presents anecdotes, examples and historical facts to illustrate each scientific concept. From The Investigating Relationships in Matter Series.

ENERGY AND THE EARTH - A SERIES - Describes the basic energy resources of the earth, showing their limitations, conservation and relationship to ecology.

ENERGY AND THE ENVIRONMENT - HOW TO LIVE ON THE EARTH A LONG TIME WITHOUT USING IT ALL UP - Focuses in depth on energy, its sources, its uses, its future and its cost to our environment.

ENERGY AND THE LAND - filmstrip with rec/cas/script - 1975 - See series title for descriptive statement. From The Human Issues in Science, Unit 1 - Ourselves Series.

ENERGY AND THE SEA - filmstrip with rec/cas/script - 1975 - See series title for descriptive statement. From The Human Issues in Science, Unit 1 - Ourselves Series.

ENERGY AND YOU - CONSERVING ENERGY - filmstrip with script - 1973 - Presents hints on ways to conserve energy in everyday living.

ENERGY AND YOU - A SERIES - Discusses energy - what it is, where it comes from, how it works, where it goes, how it is stored and how to save it. Focuses on the recognition of the many forms of energy and their sources.

ENERGY APPLIED - sound filmstrip - record - 1970 - See series title for descriptive statement. From The Environment of Man - Set I - Ecology and Environment Series.

ENERGY AT HOME AND AT WORK - filmstrip with rec/cas/script - 1975 - Discusses conversion of energy, including waste heat, efficiency of conversion and patterns of consumption affecting the conversion system. From The Energy For Man Series.

ENERGY BUDGET OF THE EARTH - filmstrip with script - From The Geology Series.

NEERGY CONVERSION - filmstrip - See series title for descriptive statement. From The Energy in Life Series.

ENERGY CRISIS, THE - AN HISTORICAL REVIEW - filmstrip with record/script - Presents a picture of the forces with which man needs to do work and what forms of energy lie ahead for us. From The School Times Kit.

ENERGY CRISIS, THE - DEPLETING THE WORLD'S RESOURCES - filmstrip with record/cassette - Points out that the United States' requirements for energy will double between now and 1985 but that if the current trend continues. American resources of natural gas, oil, coal and nuclear power will not be developed fast enough to meet our growing needs. Examines the political. economic and social ramifications of the United States becoming increasingly dependent on foreign countries for resources.

ENERGY CRISIS, THE - REPORT FROM PLANET 32 - filmstrip with record/script - Presents a dramatic fantasy account of what, in fact, can happen to the planet Earth if man is not more conscious of his environment and energy sources. From The School Times Kit - April Series.

ENERGY CRISIS, THE, PART 1 - sound filmstrip - audio tape - 1974 - Details the conflicting needs and forces at the heart of the current energy scarcity. Describes the energy requirements of industry and the effect shortages will have on the standard of living. Examines the conflicting role of government in its representation of different interests and points out the crucial choices demanded by the situation, involving rationing and spiraling inflation and energy restrictions and increased pollution.

ENERGY CRISIS, THE, PART 2 - sound filmstrip, audio tape - 1974 - Details the conflicting needs and forces at the heart of the current energy scarcity. Describes the energy requirements of industry and the effect shortages will have on the standard of living. Examines the conflicting role of government in its representation of different interests and points out the crucial choices demanded by the situation, involving rationing and spiraling inflation and energy restrictions and increased pollution.

ENERGY CRISIS, THE, PART 3 - sound filmstrip - audio tape - 1974 - Details the conflicting needs and forces at the heart of the current energy scarcity. Describes the energy requirements of industry and the effect shortages will have on the standard of living. Examines the conflicting role of government in its representation of different interests and points out the crucial choices demanded by the situation, involving rationing and spiraling inflation and energy restrictions and increased pollution.

ENERGY FLOW IN A COMMUNITY - filmstrip with record/cassette - 1973 - Uses a schematic approach to record the flow of energy through natural communities. Shows a correlation which exists between how a community member gets energy and the number of that type of member in a community. From The Ecology - Communities in Nature Series.

ENERGY FOODS - filmstrip with captions - 1960 - Describes various foods which provide energy, including carbohydrates and fats. Explains how to measure energy and to determine the food needs of both children and adults.

ENERGY FOR LIFE - filmstrip with cassette - 1974 - See Series title for descriptive statement. From The Concepts in Science, Set 7 Series.

ENERGY FOR MAN - A SERIES - Energy and our Future, Energy at Home and at Work, Food and Energy, History of Man's Use of Energy

ENERGY FOR THE FUTURE - sound filmstrip - audio tape - 1974 - See series title for descriptive statement. From The This World of Energy Series.

ENERGY FROM THE ATOM - sound filmstrip - record - 1969 - Clarifies the complexities of the release and control of atomic energy, the meaning of radioactivity and the nature of alpha, beta and gamma rays, introduces atomic fission, chain reaction, atomic fusion and explores peacetime uses of the atom in medical research and industry. From The Atomis Series.

ENERGY FROM THE SUN - filmstrip with captions - 1961 - See series title for descriptive statement. From The Elementary Science, Set 8 Series.

ENERGY IN LIFE - A SERIES - Shows the anomaly that life creates more and more complex energy systems. Suggests that the way man uses energy determines the nature of his society.

ENERGY IN THE EARTH - sound filmstrip - audio tape - 1974 - See series title for descriptive statement. From The This World of Energy Series.

ENERGY KEY TO DEVELOPMENT - filmstrip with rec/cas/script - 1974 - Describes the energy resources of Soviet Siberia and their importance in fueling growth in that region and in the Soviet Union. From The Siberia Now Series.

ENERGY LEVELS AND ELECTRON DOT DIAGRAMS - filmstrip with cassette/script - 1975 - From The Chemistry - Dissecting The Atom Series.

ENERGY OF REACTIONS - filmstrip with captions - 1964 - See series title for descriptive statement. From The Experiments in Chemistry Series.

ENERGY RELATIONSHIPS - filmstrip with captions - 1964 - See series title for descriptive statement. From The Ecology and Man, Set 1 Series.

ENERGY SOURCES - A SERIES - 1972 - Explores alternative methods for harnessing the energy necessary for us to maintain a comfortable life.

ENERGY TODAY AND TOMORROW - filmstrip

ENERGY UNLIMITED - filmstrip with captions - See series title for descriptive statement. From The Science for Better Living Series.

ENERGY, ENVIRONMENT AND THE FUTURE - 1974 - filmstrip with rec/cas/script - See series title for descriptive statement. From The Energy and The Environment - How to Live on the Earth a Long Time Without Using it all Up Series.

TEACHER'S RESOURCE LIST

In addition to those listed below, specific suggestions are also included within the packets with the activities.

1. AEA - Area Education Agency

   Check their film and book catalogs and any other material they have available.

2. Chamber of Commerce

   Contact for help in locating local solar buildings and homes, industries which may be cooperative, etc.

3. C.U.R.E. (Citizens United for Responsible Energy)
   1342 30th Street
   Des Moines, Iowa 50311 (515/277-0253)

   Contact for information and speakers.

4. Iowa Energy Policy Council
   707 East Locust
   Des Moines, Iowa 50309 (515/281-4420)

   Contact for information and speakers.

5. School custodian.

6. Utility and Power Companies.

PRINTED MATERIALS

Community Workers and the Energy They Use - curriculum and teacher materials elementary primer for second grade level, good illustrations and easy to follow. 1977
U. S. Department of Energy
Technical Information Office
P.O. Box 62
Oak Ridge, TN 37830

Energy Reporter - A free 6 page monthly flyer with current information concerning governmental, industrial, and individual advances in energy technology by Federal Energy Administration
Energy Reporter
FEA Suite 412
6611 Kenilworth Avenue
Riverdale, Maryland 20840

Alternate Sources of Energy - six bi-monthly issues for $2.00, includes how to do plans for alternate energy systems
Alternate Sources of Energy
Route 2
Milaca, MN 56353

Power and Transportation - 24 page curriculum guide (Idaho) including objectives, course construction, budget information, course outlines and occupation & job information 1975
Idaho State Board For Vocational Education
(no address available)

The Energy We Use - 42 page illustrated booklet for Grade 1 on fundamental energy 1977
U.S. Department of Energy
Technical Information Office
P. O. Box 62
Oak Ridge, TN 37830

Energy, Engines and the Industrial Revolution - 82 page informational booklet on the development of power and energy, grades 8-9 1977
U. S. Department of Energy
Technical Information Office
P.O. Box 62
Oak Ridge. TN 37830

Ears - Energy Catalog NO. 10 - catalog of commercial products such as books, posters, articles, blueprints
Ears
Invironmental Action Reprint Service
Box 545
LeVeta, Colorado 81055

FILMS

Energy Films Interim Catalog (free loan)
U.S. Department of Energy Film Library
P.O.Box 62
Oak Ridge, Tennessee 37830
(good resource listing of approx. 100 different film titles applicable to many facets of energy)

RESOURCES

Title	Description	Source
Energy Options & Energy Dilemmas	45 page booklet discussing current topics involving citizenship & responsibility for public awareness concerning energy-$1.00-mult. copy discount	League of Women Voters of the United States 1730 M StreetNW Washington, D.C. 20036
Sources of Energy- A Technical Solution	series of short informational booklets (individual) dealing with tidal, coal, oil shale, nuclear, wind, gas geothermal, hydro, wood, and solar 1977 high schl. level	Tom Baldwin, Bus. Mgr. W.I.E.A. University of Wisconsin Stout Menomonie, Wisconsin 54751
How a Bill Becomes a Law to Conserve Energy	U.S. Department of Energy 116 page book dealing with the 55 mph speed limit law high school level questionaires, studies & background information 1977	U.S. Department of Energy Technical Information Office P.O.Box 62 Oak Ridge TN 37830
Power & Energy	500 page curriculum guide listing activities program development and individual instruction methodology for high school 1977	Shawano I.E.C.P. Ainsworth Processing Ctr. Shawano, Wis. 54166
Power & Energy (Revised)	460 page curriculum guide listing instruction, activities, and organization for high school level 1974	The CBIE Project Kansas State Edger L. Webb Wichita State University Wichita, Kansas
Energy Conservation in the Home	320 page curriculum guide written for home economics but applicable for high school energy programs, listing construction uses and activities for houses	University of Tennessee Environment Center and College of Home Ec Knoxville, TN

Title	Description	Source
Transportation and the City	46 page awareness booklet discussing automobile impact on energy supply & demand Grades 8-9 1977	U.S. Department of Energy Technical Information Office P.O.Box 62 Oak Ridge, TN 37830
Raylite	Free samples available of several insulating materials	Minnesota Diversified Products Inc. 2281 Hampden Avenue St. Paul, MN 55114
The Story of Petroleum	pamplet and many others are available from the Shell people on energy	Shell Oil Co. One Shell Plaza Houston, Texas 77002
Fossil Energy	pamplet and many others are available free of charge from ERDA	ERDA Office of Public Affairs Washington, D.C. 20545
National Solar Heating	booklets available on solar hot water & your home	Solar Heating P.O.Box 1607 Rockville, MD 20850
DCA Educational	a comprehensive catalog of AV's for industrial ed including energy	DCA Educational Products 424 Valley Road Warrington, PA 18976
Nuclear Power	a good book on many facets of atomic energy	Your local American Tech book supplier
Energy Insider	A free publication on energy from the DOE	U.S. Department of Energy Washington, D.C. 20545
Handbook of Homemade Power	a book on wind, water, solar, methane & wood as a source of heat	Mother Earth News P.O.Box 70 Hendersonville, N.C. 28739
World Energy Outlook	world supplies of energy with economic, conservation trade, etc. in consideration	Public Affairs, Dept. Exxon Corp 1251 Avenue of the Americas New York, N.Y. 10020
Wis. Energy Extension Service flyers	free bulletins available on several aspects of energy	Wisconsin Energy Extension Service 1535 Observatory Drive Madison, WI 53706

Title	Description	Source
L.A.B. Corporation	This is a company that sells & services power & energy equipment, books, courses, systems, etc. in Wisconsin & Minn.	LAB Corporation 4416 River Road Afton, Minnesota 55001 LAB Corporation 1935 North 85th Street Milwaukee, WI 53226
Jack Sampson	teacher & dept. head of Energy & Trans. Dept. at UW-Stout	Jack Sampson UW-Stout Menomonie, WI 54751
Fred Posthuma	Innovative Energy Educator & Curriculum developer	Fred Posthuma Westfield HIgh School Westfield, WI
Dale Kirchner	commercial vender, knowledgeable in power & energy programs & curriculum	Dale Kirchner 1935 North 85th St. Milwaukee, WI 53226
Larry Bjurlin	commercial vender, knowledgeable in power and energy programs & curriculum	Larry Bjurlin 4416 River Road Afton, MN 55001
Fred Beyer	Ind. Arts teacher familiar with power & energy program & curriculum development	Fred Beyer Shawano High School Shawano, WI 54166
Keith Kroma	Ind. Arts teacher familiar with power & energy program & curriculum development	Keith Kroma Chippewa Falls High School Chippewa Falls, WI 54729
Edmund Scientific	a variety of nifty products related to weather, digital electronics optics, energy, etc.	Edmund Scientific 1879 Edscorp Bldg. Barrington, N.J. 08007
Power: Mechanics of Energy Control	good reference book on power and energy	local book supplier of Mcknight & Mcknight

Title	Description	Source
General Power Mechanics	good reference book on power and energy, strongest area is small engines	Local supplier of McGraw Hill
Power Technology	good reference book for power and energy	Local supplier Delmar
Energy Education	a overview of energy with AV's, sources, books, definitions, types of energy, etc.	Dr. Iver H. Johnson Mankato State University Mankato, Minn
Energy-Conservation Activity Packets	5 loose leaf booklets of activities on conservation for grades K-6 curriculum material with many tests, worksheets & activities	Iowa Energy Policy Council in cooperation with Iowa Dept. Public Instruction
Energy Conservation Workbook	18 page booklet covering many facets of conservation for home owners, including stands, R values, types of insulation and tips for do it yourselfers	Wisconsin Power & Light Co. Consumer Services P.O.Box 192 Madison, WI 53701
Federal Energy Programs	free newsletter monthly publication covering federal energy programs of interest to consumers	The Energy Consumer DOE Office of Consumer Affairs Room 8G031 Washington, D.C. 20585
Energy Conservation Ideas	small, free pamphlets covering various topics such as insulation, caulking and vapor barriers	Wisconsin Power and Light Company
A Curriculum Guideline for Power and Energy Vahan V. Basmajian	16 page course outline for energy and power at the Jr. high level March 1977	Energy and Power Journal NECEP P.O.Box 618 Concord, MA 01742
Industrial Technical Education Materials	School Shop is a monthly magazine for educators in the high school level	School Shop 416 Longshore Dr. P.O.Box 8623 Ann Arbor, MI 48107
Energy & Education	bi-monthly newsletter published by National Science Teachers Assc. The newsletter is free and contains lists of sources for information, booklets, films, as well as articles and teaching ideas	National Science Teachers Assc. 1742 Connecticut Ave.NW Washington, D.C. 20009

LIST OF STATE SUPERVISORS OF INDUSTRIAL ARTS EDUCATION
Compiled from news releases and correspondence
with the Bureau of Industrial Arts Education,
State Education Department, Albany, New York.

Alabama: Robert C. Boshell, State Department of Education, 844 State Office Building, Montgomery, AL 36130

Alaska: Ray Minge, Career and Vocational Education, Department of Education, State Office Building, Juneau, AK 99811

Arizona: Hoyt Kenmore, State Supervisors of Industrial Arts, Division of Vocational Education, Department of Education, 1535 West Jefferson Street, Phoenix, AZ 85007

Arkansas: Charles W. Easley, State Supervisor, Trade & Industrial Education, State Department of Education, Arch Ford Education Building, Little Rock, AR 72201

California: Chris Almeida, Consultant, Industrial Arts Education, 5718 Jeff Way, Carmichael, CA 95608

Colorado: Jim Wilson, Industrial Education, 207 St. Svc. Building, 1525 Sherman, Denver, CO 80203

Connecticut: David M. Mordavsky, Bureau of Vocational Services, Division of Vocational Education, Department of Education, Box 2219, Hartford, CT 06115

Delaware: Franklin D. Arbaugh, Supervisor of Industrial Arts & Occupational Programs, State Department of Public Instruction, Dover, DE 19901

District of Columbia: Marvin Lytle, Phelps Career Center, 24th & Benning, N.E., Washington, DC 20002

Florida: Ralph V. Steeb, Consultant for Industrial Arts, Florida Department of Education, Tallahassee, FL 32304

Georgia: Raymond S. Ginn, Jr., State Coordinator of Industrial Arts; Samuel L. Powell, Consultant, Industrial Arts, State Department of Education, 313 State Office Building, Atlanta, GA 30334

Hawaii: Eric Chang, Department of Education, 1270 Queen Emma Street, Room 906, Honolulu, HI 96813

Idaho: Lee Carter, State Supervisor of Industrial Arts Education, State Board for Vocational Education, 650 West State, Boise ID 83720

Illinois: John Kopatz, Consultant, Industrial Occupations; Robert O. Metzger, Department of Adult Vocational Technical Education, 100 North First Street, Springfield, IL 62777

Iowa: Harold Berryhill, Career Education Division, Grimes State Building, Des Moines, IA 50319

Kansas: Ed Henry, State Department of Education, 120 East Tenth Street, Topeka, KS 66612

Kentucky: Robert Puttoff, Industrial Education, Level II, 2109 Capitol Plaza Terrace, Frankfort, KY 40601

Louisiana: Mickey Hebert, State Department of Education, P.O. Box 44064, Baton Rouge, LA 70804

Maine: Thomas F. Birmingham, Consultant, Industrial Arts, State Department of Education, Augusta, ME 04333

Maryland: Allan B. Myers, State Department of Education, P.O. Box 8717, BWI Airport, Baltimore, MD 21240

Massachusetts: Gerard Antonellis, Occupational Education Services Team, 54 Rindge Avenue, Cambridge, MA 02140

Michigan: William E. Weisgerber, Department of Education, Vocational Technical Education Service, Box 30009, Lansing, MI 48909

Minnesota: Thomas Ryerson, Division of Vocational Technical Education, State Department of Education, Capitol Square Building, St. Paul, MN 55101

Mississippi: A.D. Nabers, State Supervisor, Industrial Arts, State Department of Education, Box 771, Jackson, MS 39205

Missouri: Eugene B. Brightwell, Supervisor of Industrial Arts, State Department of Education, Jefferson Building, Box 480, Jefferson City, MO 65102

Montana: Jeff Wulf, Trade & Industrial Education Office, State Capitol, Helena, MT 59601

Nebraska: Delmar Johnson, Nebraska State Department of Vocational Education, 301 Centennial Mall South, Lincoln, NE 68509

Nevada: John Wadsworth, Consultant, Trade and Industrial Education Department, 400 West King Street, Carson City, NV 87910

New Hampshire: Kenneth Latchaw, State Department of Education, Industrial Arts, 105 London Road, Concord, NH 03301

New Jersey: Stanley A. Grajewski, Supervisor, Industrial Arts, Department of Education, 225 West State Street, Trenton, NJ 08625

New Mexico: Albert Zamora, Supervisor, Industrial Arts, State Department of Education, Division of Vocational Education, Santa Fe, NM 87501

New York: Arthur J. Dudley, Bureau of Industrial Arts Education, 99 Washington Avenue, Albany, NY 12230; Joseph P. Indresano, Department of Defense, Department of School European Region, APO New York, NY 09164

North Carolina: Ralph Johnston, Department of Education, Industrial Arts, Raleigh, NC 27611

North Dakota: Ernest Bresnay, Supervisor, Industrial Arts Education, State Office Building, 900 East Boulevard, Bismarck, ND 58505

Ohio: Robert B. Gates, Department of Education, Room 917, 65 South Front Street, Columbus, OH 43215

Oklahoma: Harold Winburn, Department of Vocational-Technical Education, 1515 West Sixth Street, Stillwater, OK 74074

Oregon: John M. Fessant, Oregon Department of Education, 700 Pringle Parkway S.E., Salem, OR 97310

Pennsylvania: Earl R. Zimmerman, Bureau of Curriculum Services, State Department of Education, Box 911, Harrisburg, PA 17126

Puerto Rico: Franklin Ramirez, Vocational Industrial Education Program, Department of Education, P.O. Box 818, Hato Rey, PR 00919

Rhode Island: John Wilkenson, Bureau of Vocational Technical Education, Roger Williams Building, 22 Hayes, Providence, RI 02908

South Carolina: Jack Singletary, Industrial Arts, Rutledge Building, Columbia, SC 29201

South Dakota: Wyland J. Borth, Division of Elementary Secondary Education, Richard Kneip Building, Pierre, SD 57501

Tennessee: Dennis Hirch, Vocational Technical Education, 212 Cordell Hill Building, Nashville, TN 37219

Texas: Neil E. Ballard, Program Director, Industrial Arts, 201 East 11 Street, Austin, TX 78701

Utah: Joe O. Luke, Industrial Arts, State Board of Education, 250 East Fifth South Street, Salt Lake City, UT 84111

Vermont: Joseph P. Kisko, Industrial Arts Consultant, Department of Education, Elementary Secondary Education, Montpelier, VT 05602

Virgin Islands: Aubrey A. Roebuck, State Department of Education, Charlotte Amalie, St. Thomas, VI 00801

Virginia: Thomas A. Hughes, Jr., Supervisor, Industrial Arts, Virginia Department of Education, P.O. Box 6Q, Richmond VA 23216

Washington: Herbert Bell, Industrial Arts, Old Capitol Building, Mail Stop F6-11, Olympia, WA 98504

Wisconsin: William J. Ratzburg, Industrial Arts Supervisor, Wisconsin Department of Public Instruction, 126 Langdon Street, Madison, WI 53702

Wyoming: Harley Strayer, Instructional Services Division, Wyoming Department of Education, Hathaway Building, Cheyenne, WY 82002

American Samoa: Patoa Benioni, State Department of Education, Vocational Education, Pago Pago, American Samoa 96799

Mariana Island: Loren Peterson, State Department of Education, Vocational Education, Tst. Trty. Saipan, Mariana Island 96950; John Salas, Guam Com. Col. Vocational Education, P.O. Box 23069 Guam, Mariana Island, 96921

BIBLIOGRAPHY

The bibliography section contains a comprehensive list of books, pamphlets, etc. for those who can't find the material they want in the previous sections. It also contains some duplicate and more complete listings of previously listed resources, activities and projects.

BOOKS AND PAMPHLETS

Adler, Irving
Atomic Energy
John Day Company, 1971, 47pp., $3.69

Explains why atomic energy may be the only answer to fuel for power in the future.

Adler, Irving and Ruth
Coal
John Day Company, 1965, 47pp., $3.96

Traces the development of coal, how it is mined, its uses, and its many by-products.

Adler, Irving
Energy
John Day Company, 1970, $3.96

Practical examples of changes from one form of energy to another.

Adler, Irving
Petroleum: Gas, Oil, and Asphalt
John Day Company: New York, 1975, 48pp., $5.95

Aimed more towards the science-oriented. It has concise coverage of the story of oil and gas. It includes definitions, formation, location, and extraction of petroleum.

Barr, Donald
How and Why Wonder Book of Atomic Energy
Grosset & Dunlap: New York, 1961, 48pp., $1.50

Tells the development of the atomic bomb. It also describes the steps taken to learn how to use controlled atomic energy for power.

Benrey, Ronald M.
Nuclear Experiments You Can Do
Thomas A. Edison Foundation, Inc.: Michigan, 1976

Booklet containing some basic facts about nuclear energy and related experiments. Designed to aid in the understanding of nuclear energy.

Energy Reprints from ERDA
Solar Energy

A folder of solar reprints from a variety of sources that provide ideas of what can be done to apply solar energy for use in the home.

Faber, Doris
Enrico Fermi: Atomic Power
Prentice Hall, 1966

Freeman, Mae & Ira
The Story of Electricity
Random House, 1961

Haber, Heinz
The Walt Disney Story of Our Friend the Atom
Simon and Schuster: New York, 1956, 165pp.

Explanation of atomic energy provided in a combination of story and fact.

Halacy, D.S., Jr.
The Energy Trap
Four Winds Press: New York, 1975, $6.95

Describes the energy crisis, its link to the gross national product, and alternatives for current and future fuel resources.

Halacy, Daniel Stephen
Experiments With Solar Energy
W.W. Norton and Company, Inc., 1969, $4.50

Selection of materials, approximate cost, the construction and operation of devices using solar energy.

Harrison, George Russell
The First Book of Energy
Franklin Watts, Inc.: New York, 1965, 77pp.

Words and illustrations explain what energy is, kinds of energy, how energy affects the economy of the world, and what mankind could do with more energy.

Hinkelbein, Albert
Energy and Power
Watts, 1971

Historical approach to energy. Various sources of energy are described. It suggests new ways of using energy and speculates on future supplies.

Iowa Energy Policy Council
Home Energy Conservation

Booklet filled with useful information to help consumers conserve energy.

Iowa Power
"Answers to Forty of the Most Commonly Asked Questions About Electricity"

Small pamphlet available from Iowa Power which states each question and then relates answers which are simply stated and easily understood.

Iowa Power
Be Energy Wise - It All Adds Up!

Booklet designed to help citizens review constructive and up-to-date ideas on how to conserve energy in the home.

Iowa Power
Dr. Wise Use Energy Diet

Booklet available to the public which contains the cost to run every appliance in a home, and some ideas to help consumers cut down energy use.

Irving, Robert
Energy and Power
Alfred A. Knopf: New York, 1958, 140pp.

Describes work, power of different types, sources of energy other than fuels, and energy of the future.

Kelman, Peter and A. Harris Stone
Ernest Rutherford: Architect of the Atom
Prentice Hall, 1969

Kiefer, Irene
Underground Furnaces: The Story of Geothermal Energy
William Morrow and Company, Inc.: New Jersey, $4.95

Easy but accurate explanations of how four kinds of "hot spots" are formed and how they can be transformed into usable energy.

Knight, David C.
Harnessing the Sun: The Story of Solar Energy
William Morrow and Company: New York, 1976, $5.95

Tells of past and present work in the field of solar energy and speculations on what may lie ahead.

Marshall, James
Going, Going, Gone?
Coward, McCann and Geoghegan, Inc.: New York, 1976, $5.49

Consideration is given to the waste of energy resources by Americans. Tells us how and why we allow waste to continue.

Mattison, C.W.
Man and his Resources in Today's World
Creative Educational Society: Mankato, Minnesota, 1967, 150pp., $6.95

Book on man's resources which is well illustrated. It emphasizes conservation and touches on pollution. Also includes future power resources.

Millard, Reed
Natural Resources: Will We Have Enough for Tomorrow's World?
Messner, 1972

Each chapter begins with a question relating to a specific natural resource and the possibility of their depletion. Also provides suggestions for further reading.

Moore, Jordan
Energy
Grosset & Dunlap: New York, 1967, 61pp.

Provides examples of many types or sources of energy and also experiments for a better understanding of what energy is.

National Dairy Council
How Your Body Uses Food
28pp., $.25 per copy

Graphic art, photographs, and text emcompassing easy, safe experiments with foods, challenge for growth, energy and health. The booklet can be useful in science, health, and nutritional studies.

National Wildlife Federation
The Best Present of All
National Wildlife Federation: Washington, D.C.

Comic brochure on energy for children.

Office of Conservation Education
Energy Conservation: Understanding and Activities for Young People
U.S. Government Printing Office: Washington, D.C. 20402
Stock No. 041-018-00091-7, 1975, $.85 per copy

Booklet written in language understandable for the upper elementary and junior high student. The material on energy, its uses, and conservation aids the student in his understanding. The suggested activities are interesting.

Podendorf, Illa
The True Book of Energy
Children's Press: Chicago, 1971

Book relates the importance and kinds of energy to children's own experiences. The book contains short sections and many illustrations.

Pringle, Lauren
Energy: Power for People
Macmillan Publishing Company, Inc.: New York, 1975, $6.95

Author urges young people to face the facts about the energy supplies of the earth.

TCI Advertising, Inc.
The Atom and the Energy Crunch
Reddy Communications, Inc., 1976

Available from Iowa Power. Booklet containing information on the energy crisis; what has caused it, nuclear energy, future energy sources.

TCI Advertising, Inc.
Coal and the Energy Crunch
Reddy Communications, Inc., 1976

Available from Iowa Power. Information on sources of coal, value as an energy source, problems due to use of coal, and the importance of planning ahead.

TCI Advertising, Inc.
Electric Utilities and the Energy Crunch
Reddy Communications, Inc., 1976

Available from Iowa Power. Information to aid in the understanding of where electricity comes from and why the supply of power is threatened.

Reuben, Gabriel H. and Joseph Di Stefano
What Is An Atom?
Benefic Press, 1960

Ross, Frank
The World of Power and Energy
Lothrop, Lee and Shepard, 1967, $4.32

Sun, sky, water, earth, fossil fuels, chemical and atomic energy. The book also concerns itself with energy from the depths of the earth.

Ruchlis, Gyman
Thank You, Mr. Sun
Harvey House Publishers: New York, 1966, 45pp.

Provides many illustrations of how the sun helps mankind and nature.

Shuttlesworth, Dorothy E. and Lee Ann Williams
Disappearing Energy
Doubleday and Company, Inc.: New York, 1974, 96pp., $5.95

Good resource book which presents factual data on the use and misuse of energy. Also reviews what has been done in regards to conservation but does not look into the possible future solutions.

Smith, Norman F.
Sun Power
Coward, McCann and Geoghegan, Inc.: New York, 1976, 46pp., $4.64

Everything that lives and grows on the earth uses energy from the sun. Gives a new understanding and appreciation of the sun, our chief energy source.

Syrocki, Ed.D.
What Is Electricity?
Benefic Press, 1960

Szulc, Tad
The Energy Crisis
Franklin Watts, Inc.: New York, 1974, 128pp., $6.95

Author reveals many disturbing items in relation to the energy crisis and why it is here. It also contains an explanation of why the energy crisis will continue into the future.

Thomas A. Edison Foundation, Inc.
Energy Conservation: Experiments You Can Do
Michigan, 1974, 32pp.

Booklet containing many energy conservation experiments designed to bring about a better understanding of how energy can be conserved at the present time.

Wohlrabe, Raymond A.
Exploring Solar Energy
The World Publishing Company, 1966, 89pp.

Identifies early history of sun worshipers, how the sun provides heat and light which can be turned into electricity. It also discusses the uses of solar energy for the future.

Zim, Herbert
Waves
Morrow, 1967, $3.78

Brief useful introduction of tidal waves and underwater earthquakes.

BOOKS AND PAMPHLETS

Asimov, Isaac
Electricity and Man
U.S. Atomic Energy Commission
U.S. Government Printing Office, 1974

An informative booklet intended to aid citizens in understanding the vital force of nuclear energy. This and other information booklets, are available for the general public. School and public libraries may obtain a complete set without charge. Available from: USAEC - Technical Information Center, P.O. Box 62, Oak Ridge, Tennessee 37830.

Asimov, Isaac
Worlds Within Worlds: The Story of Nuclear Energy, Vol. 1, 2, 3
U.S. Energy Research and Development Administration

Three comprehensive booklets including atoms, electricity, and energy showing how man has learned to produce and control nuclear energy.

Cottrell, Frederick W.
Energy and Society: The Relation Between Energy, Social Change, and Economic Development
McGraw, 1955, 330pp., $15.00

Survey which examines the use of energy in low and high energy societies.

Daniels, Farington
Direct Use of the Sun's Energy
Ballantine Books: New York, 1974, 271pp., $1.95

Provides a review of the potential of solar energy and urges additional research. Fun and informative books which could also spark projects and solar experiments.

Energy Research and Development Administration
Creating Energy Choices for the Future
Office of Public Affairs: Washington, D.C. 20545, 1975

A booklet designed to improve the understanding of the U.S. energy policy.

Federal Energy Administration
Organizing School Energy Contests
Washington, D.C. 20461

Helpful brochure encouraging the formation of school energy contests. Guidelines are given as to the processes involved.

Federal Energy Administration
Tips for Energy Savers
Washington, D.C. 20461

Helpful booklet filled with many useful and simple ways to save energy. Designed for individuals and families, but also contains a teaching guide for teachers to help students bring these tips to the concern of the family.

(Ford Foundation Energy Policy Project)
A Time to Choose: America's Energy Future
Ballinger: Massachusetts, 1974, 511pp., $12.95

Final report of a three-year, $4 million study. Reflects the conviction that America can and should have a national energy policy that serves the needs of all people.

Fowler, John W.
Energy - Environment Source Book
National Science Teachers Association, 1975

Designed for teachers who wish to incorporate a study of energy into their teaching. It is divided into two volumes, each with many charts, tables, figures.

Fritsch, Albert J. and others
Energy and Food: Energy Used in Production, Processing, Delivery, and Marketing of Selected Food Items
Center for Science in the Public Interest, 1975, 80pp.

The authors suggest ways to reduce the input of energy in food processing.

Hammond, Allen L., William D. Metz and Thomas H. Maugh II
Energy and the Future
American Association for the Advancement of Science: Washington, D.C., 1973, 184pp., $3.95

Gives an introduction to each of the present and possible future energy sources. It also covers energy conservation and energy policy.

Halacy, D.S., Jr.
Wind, Sun, and Water: Our Energy Alternatives
Harper, 1977, 192pp., $9.95

Easily read. The renewable resources of geothermal, water, tidal, sea thermal energy, wind, biofuels, and solar energy are presented for consideration.

Hayes, Dennis
Energy: The Case for Conservation
Worldwatch Paper, 1976, 77pp.

Review of the economics of energy expenditures and contains many good charts and graphs.

Hodges, Laurent and John Neff
Solar Energy: 1976
Report from the Iowa Energy Policy Council, June, 1976

Descriptive report of some uses to which solar energy is being put and anticipation for further uses.

Iowa State Department of Public Instruction
Energy Conservation in School Facilities

Brochure designed to encourage energy conservation in school facilities. Specific recommendations for reducing energy waste are proposed.

Lapp, Ralph E.
The Nuclear Controversy
Fact Systems: Connecticut, 1974, 93pp.

Especially interesting to foes of nuclear fission.

Lemish, Dr. John
Mineral Deposits of Iowa
Iowa Southern Utilities Company
Craftsman Press, Inc.: Burlington, April, 1969

Excellent resource for Iowa teachers as it is a statement of the mineral deposits and their potentials in the state of Iowa. Some of the information can be condensed and revised for use with upper elementary students.

Miller, Roger LeRoy
The Economics of Energy: What Went Wrong?
Morrow, 1974, 131pp., $4.95

Short review which includes criticism of living the simple life and price controls.

Olin, Dr. Hubert L.
Coal Mining in Iowa
State Mining Board
State of Iowa: Des Moines, Iowa, 1965

Booklet which presents the early history of coal mining in Iowa, its importance as a resource of the state, and its role in the development of Iowa's economy.

Rocks, Lawrence and Richard P. Runyon
The Energy Crisis
Crown: New York, 1972, 189pp., $2.95

Review of sources of energy, impending crisis, resolutions for the problems the U.S. is presently facing.

Simmons, Henry
The Economics of America's Energy Future
U.S. Energy Research and Development Administration, Office of Public Affairs: Washington, D.C. 20545, 1975

Booklet which reviews the role of energy in American life, trends in energy supply, and highlights various forms of energy.

Steinhart, Carol and John Steinhart
The Fires of Culture: Energy Yesterday and Tomorrow
Duxbury, 1974, 273pp., $4.95

A general introduction to energy. Contains material on energy policy, energy and food.

Stolp, Richard N. and Frederick P. Deluca
Perspectives on Iowa Coal
Energy and Mineral Resources Research Institute, Iowa State University: Ames, Iowa 50011, 1976

Colorful and easily understood report on the Iowa Coal Research Project which provides information for interested Iowans.

Swatek, Paul
The User's Guide to the Protection of the Environment
Friends of the Earth, 1970, 305pp.

Paperback which provides specific information on daily decisions which could improve or deteriorate a person's environment. Packaging products, cleansers, energy consumption in the home, are examples of topics the book covers.

Tuthill, Dr. Samuel and Maurice Van Nostrand
Our Energy Needs: Questions and Answers
1973

Very helpful material regarding an energy shortage in the U.S., related in concise form. Helpful to Iowa teachers at all levels.

Udall, Steward and others
The Energy Balloon
McGraw, 1974, 288pp., $7.95

Author urges development of new attitudes and leaner life-styles in order that there will not be as much wastefulness.

U.S. Department of Commerce
Energy: Critical Choices Ahead
Office of Energy Programs, May, 1975

Brochure designed to put the energy problem into perspective and to give indications of the efforts required to meet energy needs.

U.S. Environmental Protection Agency
Questions and Answers About Nuclear Power Plants
U.S. Environmental Protection Agency: Washington, D.C., Revised, 1973

Pamphlet designed to answer many questions which have arisen concerning nuclear power plants and the environment.

ANNOTATED TEACHER'S BIBLIOGRAPHY

CURRICULUM GUIDES AND RESOURCE BOOKS

American Gas Association, Education Services, 1515 Wilson Boulevard, Arlington, Virginia 22209

Provides many booklets, pamphlets, kits, filmstrip on natural gas. Specifically for grade 5 you may be interested in "Natural Gas Serves Our Community Kit"--N00160 and "Flames and Energy"--N81070.

A Teacher's Introduction to Energy and Energy Conservation
Ohio Department of Education, 1975
Battelle Center for Improved Education, 505 King Avenue, Columbus, Ohio 43201 (ED 127 160)

Guidelines on energy and energy conservation. Provides teacher orientation to energy education and general suggestions for teaching units.

CEL Blocks
Primary Interdisciplinary Environmental Learning Packets, Brevard County, Florida (ESEA Title III, Project #050-2323-73003)

Student cards covering areas of environmental education which can be used by teachers in a variety of interdisciplinary ways.

Energy
Environmental Education Project, ESEA Title III, Section 306
Topeka Public and Parochial Schools, 1601 Van Buren, Topeka, Kansas 66612 (ED 093 649)

Objectives are listed, along with activities which meet the stated objectives. Teachers select only those appropriate to the objectives for their students.

Energy
Michigan United Conservation Clubs, P.O. Box 30235, Lansing, Michigan 48909

Provides information on the nature of energy, sources and uses of energy, and conservation. There are also some work sheets and ideas for helping others learn more about energy.

Energy
Social Issues Resource Series, Eleanor C. Goldstein, c. 1975.
Social Issues Resource Series, Inc., 1200 Quince Orchard Boulevard, Gaithersburg, Maryland 20760

Notebook filled with reprints of articles related to energy.

The Energy Challenge
Federal Energy Administration
The Energy Challenge, Box 14306, Dayton, Ohio 45414

Twenty-five spirit duplicating activity masters designed for grades 5 through 8. Also contains a teacher's guide section.

Energy Conservation Classroom Kits 1-3, 4-6
Southern California Edison Company, c. 1976
Educational Services, Room 397, P.O. Box 800, Rosemead, California 91770

Colorful kits to help teachers teach about energy conservation. There are folders, inspector cards, stickers, certificates. The teacher's guide contains ideas and lesson plans, in addition to duplicating masters.

The Energy Crisis: What You Can Do About It
Standard Oil Company (Indiana), c. 1973
Mail Code 3705, 200 E. Randolph Drive, Chicago, Illinois 60601

Folder containing four spirit masters and specific teaching instructions. The spirit masters give information and ask for students to supply some interpretation. Parents and other adults are encouraged to participate.

Energy Crisis Teaching Resources
Curry, Wendell, et. al., Oregon State Board of Education, Salem, Oregon, 1973, 59 pp. (ED 085 316)

Many very useful activities to be used in stressing individual responsibility towards energy crisis problems.

Energy - Environment Materials Guide
Kathryn E. Mervine and Rebecca E. Cawley
National Science Teachers Association, Washington, D.C., 1975
(ED 111 663)

Handy source book containing annotated bibliographies for teachers, students, non-print material.

Energy - Environment Mini-Unit Guide
Smith, Stephen M., Editor, c. 1975
National Science Teachers Association, Washington, D.C. (ED 111 664)

Materials designed to stimulate decision making in young children and to make teaching more interdisciplinary. It is filled with many activities and guidelines.

Energy for Today and Tomorrow
San Diego City/County Schools Energy Education Committee
Department of Education, San Diego County, 6401 Linda Vista Road, San Diego, California 92111, 1975

Activities for students in grades kindergarten through six. These help to create an awareness of the need of dealing with energy problems.

Energy and Man's Environment
Jones, John, D.Ed., Editor, 1976
Energy and Man's Environment, Inc., 0224 S.W. Hamilton, Suite 301, Portland, Oregon 97201

Interdisciplinary teacher's guides to energy and environmental activities. Involves 8 books - Activity Guide, Uses of Energy, Sources of Energy, Impacts of Energy, Limits of Energy, Conversion of Energy, Future Sources of Energy, Glossary.

Energy and Man's Environment - Activity Guide
Ris, Thomas F.
Energy and Man's Environment, 2121 Fifth Avenue, Seattle, Washington 98121 (ED 106 070)

Provides educational strategies and materials needed for introducing energy to all grade levels on an interdisciplinary basis. Each chapter has four themes: (1) Scientific, (2) Ethical, (3) Aesthetic, (4) Utilitarian.

Energy Activities for the Classroom - 1976
Coon, Herbert L. and Michele Y. Alexander, 1976
ERIC Center for Science, Mathematics, and Environmental Education
College of Education, The Ohio State University, 1200 Chambers Road, Third Floor, Columbus, Ohio 43212

Resource booklet of energy teaching activities divided into grade levels: K-3, 4-6, 7-9, 10-12.

Environmental Education: Strategies for Wise Use of Energy
Division of Science Education, North Carolina Department of Public Instruction, Raleigh, North Carolina 27611, c. 1974

Designed for use at all grade levels, therefore, activities are grouped K-3, 4-6, 7-12. An appendix contains charts, glossary, bibliography, checklists.

Fun With the Environment
Environmental Protection Agency
Washington, D.C., 1973, 20pp. (ED 103 213)

Activity booklet which helps young children learn about their environment. The booklet has a cartoon and coloring book format.

Heirarchy Chart
John Muir Institute for Environmental Studies, Inc., 2118-C Vine Street, Berkeley, California 94709

Comprehensive total concept chart which was to be used in developing environmental studies curricula to supplement existing K-12 programs.

Living Within Our Means: Energy and Scarcity
Environmental Educational Instructional Activities K-6
The University of the State of New York, The State Education Department, Albany, New York 12234

Instructional manual which illustrates ways in which environmental concerns may be integrated into the curriculum. Excellent activities arranged according to disciplines.

"Mickey Mouse and Goofy Explore Energy"
Walt Disney Productions, 1976
Public Affairs Department, EXXON, U.S.A.
P.O. Box 2180, Houston, Texas 77001

Very comprehensive, yet delightfully presented energy comic book. Copies are available from the above address. Covers previous sources of energy and possible future sources.

My Energy is Your Energy
Arizona Department of Education, February, 1974

Resource book and conservation activities designed for K-12.

Nuclear Power - Meeting a Need a New Way
Cedar Rapids Community Schools, 346 2nd Avenue, S.W., Cedar Rapids, Iowa 52404, c. 1972

Provides good suggestions as to teaching about nuclear power.

Student Learning Activity Module "The Energy Crisis"
Hughes, Judi and Lee County Environmental Education Program
Title III ESEA, 2266 Second Street, Fort Myers, Florida

Contains lesson plans, resource materials, and a Student Teaching Module on energy. Developed to help create an awareness of the causes, and some solutions for the energy crisis the world is facing.

Teacher's Handbook of Energy
Colorado Department of Education, Denver, Colorado 80023, c. 1974
(ED 119 957)

Provides teachers with information on energy and instructional activity suggestions.

Ways to Environmental Education, Volume III
Allen, Rodney F., Ed. and Others
Florida State University, Tallahassee College of Education, Tallahassee Junior Museum, Florida, 1975, 150pp.

Ten environmental booklets in one volume. One booklet covers energy learning activities for camp and home.

Wide World of Energy Kit
Walt Disney Productions, 1976
Walt Disney Educational Media Company, 500 South Buena Vista Street, Burbank, California 91521

Kit contains cassette and color filmstrip titled, "The Search for Power and Energy;" 18 full-color study prints; Energy Game; 30 copies of the energy comic book, "Mickey Mouse and Goofy Explore Energy;" 10 energy activity cards; teacher's guide with information and additional activities.

ANNOTATED TEACHER'S BIBLIOGRAPHY

EDUCATIONAL JOURNAL ARTICLES

Asimov, Isaac
"The Fascinating Story of Fossil Fuel"
National Wildlife
Vol. 11, November 5, August-September, 1973

Colorful charts could be helpful material for teachers.

"Energy Consumers Turn into Conservationists"
Nation's Schools
93: 4: 26-28, April, 1974

Describes how the topic of energy conservation has been introduced into school curriculums. Salem, Oregon; Marshalltown, Iowa; Des Moines, Iowa; Buckingham, Pennsylvania are mentioned specifically.

Fowler, John M.
"Does the Energy Theme Belong in the Classroom?"
Today's Education
65: 88-9, March, 1976

Teachers are encouraged to put more emphasis on energy education in the schools. Suggestions are given to make it interdisciplinary and goals are stated which aim to prepare the "students of today - citizens of tomorrow" for life.

Fowler, John M.
"Energy, Education, and the 'Wolf' Criers"
Social Education
pp. 245-256, April, 1976

Examines the background to the current energy crisis and outlines some possible solutions to the problems.

Glickman, L. J.
"Teaching Guide on Energy"
American Education
11: 40, June, 1975

Reviews an informative handbook entitled Energy Crisis Teaching Resources: A Special Publication Suggesting School Activities Which Stress Individual Responsibility Towards Energy Crisis Problems which was initially written for Oregon's Energy Crisis Week (December, 1973).

Hankla, Alice Kimbler
"An Energy Conference for Little People"
Science and Children
Vol. 12, No. 7, pp. 5-7, April, 1975

Reviews a conference which was held for children ages 4 and 5 at which they learned what energy is, how it works, and devised methods of energy conservation.

Harder, Peter J.
"Activity Cards Bridge Science and Social Studies"
Science and Children
Vol. 12, No. 7, pp. 8-10, April, 1975

Utilizing photography, the author developed a series of local photos to be made into activity cards with the questions on the back. Several different approaches to using the cards were suggested.

Hawkins, M. E.
"Energy: Future Alternatives and Risks"
Science Teacher
41: 25-7, April, 1974

Review of a two-day Academy Forum on Energy sponsored by the National Academy of Sciences. The Forum took up six propositions regarding energy. Many ideas were brought before the assembly.

Johnson, W. A.
"Energy Cricis: Not Only Why But What Can We Do?"
NASSP Bulletin
58: 28-36, May, 1974

Author expresses that the reason the U.S. is a nation of energy spendthrifts is that we have been paying far too little for the energy we use. Feels that a rise in prices will provide the incentive for conservation.

Kenick, L. E.
"Energy Teaching Centers"
Science Teacher
43: 34-5, May, 1976

Author proposes setting up Energy Teaching Centers within a community for school children, parents and homeowners, and teachers. These centers would provide means for the local population to explore and encounter energy alternatives.

Kirman, J. M. and M. A. Nay
"Joint Planning for Integrating Social Studies and Science: Teaching About the Energy Crisis"
Social Education
39: 77-80, February, 1975

The authors express the hope that by encouraging the integration of social studies and science, schools will begin the process of providing an integrated curriculum.

Messer, Melanie B.
"Energy for Today and Tomorrow with Energy Eagle"
Science and Children
Vol. 14, No. 3, pp. 18-20, November/December, 1976

Delightful energy awareness activities produced by the San Diego County Department of Education for use with elementary students. Teachers are encouraged to adapt these to their own local situations.

Nesbitt, William A.
"The Energy Question: Problems and Alternatives"
Intercom
pp. 12-16, September, 1973

Proposes some ideas for teaching about the energy questions, charts, background information and data, and some suggested solutions with both the advantages and disadvantages.

Post, T. R.
"Energy Crisis: An Opportunity for Meaningful Arithmetical Excursions"
Arithmetic Teacher
22: 61-4, January, 1975

Suggests math activities which provide meaningful situations. Emphasis is to help students become sensitive to the implications a national crisis could bring.

Sartwell, J. G. and R. P. Abell
"Teacher's Guide to the Energy Crisis"
Today's Education
64: 90-7, January, 1975

Authors present facts about energy use, questions for students and teachers, alternative sources of energy, ideas for classroom use, and resources which are available.

Sommerkamp, P.
"Energy Crisis Gameboard"
Science Teacher
42: 39-40, June, 1975

Describes a game devised by students in Kentucky as a result of their study of energy. There are two versions - one without cards and one with cards.

"Starting Points - Energy: Plugging into the Fuel Crisis"
Learning
Vol. 2, No. 4, December, 1973

Aimed at teachers of K-8. Contains a series of activities to help students understand what energy is, as it flows through our life.

Yant, S. L.
"Facing the Energy Crisis in a Mathematics Classroom"
Arithmetic Teacher
23: 223-4, March, 1976

Teacher relates specifics of an eight-day project within a math class that created practical applications to the energy crisis.

MULTI-MEDIA MATERIALS

"The American Dream is Running Out of Fuel"
18 minutes, color, $230 or $19-rent (Gr. 5-8)
Films, Inc.
1144 Wilmette Avenue
Wilmette, Illinois 60091

"Bate's Car: Sweet as a Nut"
16 minutes, 16mm, color, $230 or $30-rent, 1975 (Gr. 5-12)
Arthur Mokin Productions
17 W. 60th Street
New York, New York 10023

Presents the inventor's energy-saving inventions, particularly his methane-driven automobile. Highly recommended by AAAS.

"Coalmining: The Story of Buried Sunlight"

Filmstrip, elementary

Ecology Activity Cards
BFA Educational Media
2211 Michigan Avenue
Santa Monica, California 90404

Some of the activities related specifically to energy. Others in the box guide the children towards conservation and the idea of using our resources wisely.

Ecology: Understanding the Crisis
Series No. 6454, c. 1972
Encyclopaedia Britannica Educational Corporation
425 North Michigan Avenue
Chicago, Illinois 60611

Filmstrip, records, guides. General coverage of what has caused the crisis, how man relates to his environment, a look into the future.

"The Economics of the Energy Problem"
Economic Topic Series
Teaching Resource Films, 1976

Sound filmstrip. Provides a basic overview of the energy problem.

"Electricity"
Community Series: Systems in Our City

Elementary level filmstrip.

"Electricity from Heat and Sunlight"
8mm film loop, color, with teacher's guide, $23.50 (Gr. 4-12)
Doubleday Multimedia

Shows how electricity can be produced from heat and sunlight.

"Energy"
Iowa Petroleum Committee

"Energy: A First Film"
8 minutes, sound, color (Gr. K-3)
BFA Educational Media
2211 Michigan Avenue
Santa Monica, California 90404

"Energy: Ability to Do Work"
9 minutes, color, sound (Gr. 5-8)
AIMS Instructional Media Service
P.O. Box 1010
Hollywood, California 90028

"Energy and Power - A First Look"
10 minutes, 16mm, 1962 (Primary - Intermediate)
Journal Films

Outlines, from the days of the caveman to the present, many ways in which man harnesses energy and increases his capacity to do work by utilizing the potential energy found in wood, wind, and running water.

"The Energy Challenge" - Kit, c. 1975
Pollution Control Education Center
Township of Union Public Schools
Union, New Jersey

Grade level undesignated, however, could be used in Gr. 6 with some modification and for the junior high. Contains student booklets, teacher's guide, two filmstrips with cassette, duplicating masters, activity cards, and overhead transparencies.

"Energy Crisis"
13 minutes, 16mm, color, 1972 (Gr. 4-9)
Journal Films

Reviews the different energy sources and indicates the length of time we may be able to depend on them. Shows the possibility of solutions and developments which may some day provide unlimited power to meet our needs.

"Energy Crisis Game," 1973 (Upper elementary and junior high)
Intemation, Inc.
New York, New York 10001

For 2-6 players.

"Energy Game"
Northern Natural Gas"

Twenty minute slide and sound show followed by a quiz, designed for grades 4-6. The stress is upon energy conservation with a short review of where energy comes from.

"Energy With a Capital C - for Conservation"
Energy Policy Council
707 East Locust
Des Moines, Iowa 50319

Slide presentation complete with slides, audience pamphlets, and a recorded cassette of the slide narrative.

"First Film on the Wind"
9 minutes, 16mm, color, sound, c. 1966 (Elementary)
BFA Educational Media
2211 Michigan Avenue
Santa Monica, California 90404

Shows how, though one cannot see the wind, he can see what the wind does, such as making waves on the water, swaying trees, and lifting kites. Shows how rain clouds come and go with the wind.

"Global Emergency: Energy"
Guidance Associates, c. 1975 (Gr. 6)

Two sound filmstrips, "New Sources, New Values" and "The Energy-Aware Society," which deal with the various alternative sources of energy. It also looks at the social, economic, and political problems in our world of shortages. The students also look at alternative life-styles.

"The Great Search: Man's Need for Power and Energy"
13 minutes, 16mm, color, with teacher's guide, 1972 (Gr. 4-up)
Walt Disney Production

Traces history of man's attempts to harness energy of sun, water, lightning, etc. in order to produce power needed for daily living.

"Man's Search for Energy"
Filmstrip, 36 frames, $6.75 (Gr. 5-8)
McGraw-Hill Films
1220 Avenue of the Americas
New York, New York 10020

"Our Energy-Based Economy"
EEI Pub. No. 74-54
Edison Electric Institute

A multi-media instructional program for Gr. 6-8. Contains four filmstrips, four records, duplicating activity sheets, duplicating pre/post assessment sheets, and a teacher's guide.

"Our Energy Supply"
Part of The Only World We Have Series (Gr. 6)
Narrated by Dr. Leonard Reiffel and Miss Moones, Bell and Howell

Twenty minutes, two-part tape. Presents a wide variety of the problems relating to our energy usage. Covers definition of energy, present sources, explains origin of our energy problem, possible energy sources.

"The Petrified River"

Film available from Iowa Electric Light Company.

"Power"
Color filmstrip, 53 frames. Sound with cassette or record. (Intermediate - Junior High)
From Water and How We Use It Series, 1971
6 filmstrips with cassettes, $70.00; with records, $55.00
Coronet Instructional Films

Shows how water power helped the development of early industry and how water supplies power for hydroelectric energy from the water and how we use it.

"Power and Energy"
Set of two filmstrips, record or cassette, automatic and manual, $25.00 per set
18-20 minutes, color, 50-59 frames, with teacher's guide (Gr. 5-9)
Educational Activities

Answers such questions as: Where does energy come from? How is it produced and distributed? Why are there "Brown-outs?" How do you produce power from fossil fuels, fission, fuel cells, ocean, solar energy?

"A Practical Guide to the Energy Crisis," 1975
Schloat Productions Distribution Center
West Nyack, New York 10994

Two excellent color filmstrips, two records or cassettes. Part One: "Reasons for the Crisis," 89 frames, 10 minutes. Part Two: "Responding to the Crisis," 78 frames, 11 minutes. (Gr. 6-8)

"Science and Society: An Inquiry Into Technology and Values: Energy," 1975
Schloat Productions Distribution Center
West Nyack, New York 10994

Excellent sound filmstrip program containing two filmstrips with cassettes. Filmstrip I - "Power Struggle," 101 ft., 19 minutes. Filmstrip II - "Future Power," 103 ft., 19 minutes. (Gr. 6-8)

"This Earth: Everything Fits Together," 1973
Guidance Associates

Multi-media learning experience for the elementary years. Children see that everything is interdependent and that the sun is the energy source for all life on earth. Sound filmstrips, study cards, poster, game poster, stencils, work sheets, and teacher's guide.

"The World of Energy"
Filmstrip (Gr. 5-8)
National Geographic Society
Department 1037
Washington, D.C. 20036

Developed by:

Russell J. Moniz,
Graduate Assistant

Dept. of Energy & Transportation
UW-Stout
Winter - 1976-77

BIBLIOGRAPHY

Abelson, Philip H. Energy for Tomorrow, Seattle, Washington; University of Washington Press, 1975.

Abelson, Philip H. Energy: Use, Conservation, and Supply. Washington, D.C.; American Association for the Advancement of Science, 1974.

Asinov, Isaac Electricity and Man. Oak Ridge, Tennessee: ERDA, 1972.

_____, A Time to Choose, America's Energy Future. Cambridge, Mass.: Ballinger Publishing Company, 1974.

Cook, Earl Man, Energy, Society. San Fransisco, California W.H. Freeman and Company, 1976.

Coonley, Douglas R. Design with Wind. Harrisville, N.H.; Total Environmental Action, 1974.

Davis, David Howard Energy Politics. New York, N.Y. St. Martins Press, Inc., 1974.

* Daniels, Farrington Direct Use of the Sun's Energy. New York, N.Y., Yale University Press, 1964.

_____, Definition Report: National Solar Energy Research, Development, and Demonstration Program. Washington, D.C. Energy Research and Development Administration, 1975.

_____, Directory of the Solar Industry. Hampton, New Hampshire Solar Data, 1976.

_____, Energy, Environment, and Education. Washington, D.C. The Conservation Foundation, 1973.

_____, Energy Options. Los Angeles, California; Environmental Education Group, 1973.

Environmental Education Curriculum; Air Pollution. Topeka, Kansas Topeka Public and Perochial Schools, 1972.

Environmental Education Curriculum; Electrical Production and Pollution Control. Topeka, Kansas; Topeka Public and Perochial Schools, 1974.

_____, Environmental Education Curriculum; Energy and You. Topeka, Kansas Topeka Public and Perochial Schools, 1974.

Environmental Education Curriculum; Water Pollution; Topeka, Kansas Topeka Public and Perochial Schools, 1973.

* Indicates highly recommended material.

_____, Federal Wind Energy Program. Washington, D.C. National Technical Information Service, 1975.

Flanagan, Dennis (Ed.) Energy and Power. San Fransisco, California Scientific American, Inc., 1971.

Fowler, J.M. and Mervine, K.E. Energy and the Environment. College Park, Maryland University of Maryland, 1973.

Freeman, S. David Energy: The New Era. New York, N.Y.; Vintage Books, 1974.

Gabel, Medard Energy, Earth and Everyone. San Francisco California: Straight Arrow Books, 1975.

Gay, Larry Heating With Wood. Charlotte, Vermont: Garden Way Publishing, 1974.

Hammond, Allen L. Energy and the Future. Washington, D.C.; American Assoc. for the Advancement of Science, 1973.

Hammond, Allen L., Williams, D., Maugh, Thomas H. II. Energy and the Future Washington, D.C. American Association for the Advancement of Science, 1973.

Healy, Timothy J. Energy, Electric Power, and Man. San Francisco California Boyd & Fraser Publishing Company, 1974.

Healy, Timothy J. Energy and Society. San Francisco, California Boyd & Fraser Publishing Company, 1976.

Holdren, John and Philip Herrera Energy: A Crisis in Power. San Francisco, California; Sierra Club, 1971.

*James, Glenn D. Energy Potpourri: Ideas for Today and Tomorrow. Sono Publishers, Los Angeles, California

Leckie, Jim Other Homes and Garbage, Designs for Self-Sufficient Living. San Francisco, California; Sierra Club, 1975.

Lyerly, Ray L. and Mitchell, Walter III Nuclear Power Plants. Oak Ridge Tennessee; Technical Information Center, 1967.

Meador, Roy Future Energies. Anne Arbor, Michigan Anne Arbor Science Publishers, Inc., 1974.

National Research Council San Francisco, California; National Academy of Sciences, 1969.

_____, NSF/NASA Wind Generator System Program. General Electric, 1974.

_____, Project Independence; Coal, Washington, D.C. Interagency Task Force on Coal, 1974.

_____, Project Independence; Geothermal Energy. Washington, D.C. Interagency Task Force on Geothermal Energy, 1974.

_____, Project Independence; Natural Gas. Washington, D.C. Interagency Task Force on Natural Gas, 1974.

_____, Project Independence; Nuclear Energy. Washington, D.C. Interagency Task Force on Nuclear Energy, 1974.

_____, Project Independence; Solar Energy. Washington, D.C. Interagency Task Force on Solar Energy, 1974.

Putnam, Palmer C. Power From the Wind. New York, N.Y.; S. Morgan Smith Company, 1948.

Schurcliff, William A. Informal Directory of the Organizations and People Involved in the Solar Heating of Buildings. Cambridge, Massachusettes, 1975.

Scientific American Energy and Power. San Francisco, California; W.H. Freeman and Co., 1975.

_____, Solar Energy Hardware Manufacturers List. Harrisville, N.H. Total Environmental Action, 1975.

Solar Energy Heating and Cooling Products. Oak Ridge, Tennessee; Energy Research and Development Administration, 1975.

_____, Solar Energy Home Design; in four climates. Harrisville, N.H. Total Environmental Action, 1975.

Sterland, E.G. Energy Into Power. Garden City, New York Natural History Press, 1967.

Tilly's Catch-A-Sunbeam Coloring Book. Cherry Hill, New Jersey Solar Service Corporation.

*Whole Earth Truck Store and others Energy Primer. Menlo Park, California Portola Institute.

Williams, Richard J. Solar Energy; Technology and Applications. Anne Arbor, Michigan: Anne Arbor Science Publishers, Inc. 1974. ($6.95 soft cover)

Wilson, Richard and Jones, William J. Energy, Ecology, and the Environment. New York, N.Y. Academic Press, Inc., 1974.

*Halacy, D.S. Solar Science Projects. Scholastic Book Services, Englewood Cliffs, N.J. ($.85)

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_____, Rapid Growth From Energy Projects. Washington, D.C. Dept. of Housing and Urban Development, 1976.

Stoner, Carol Hupping. Producing Your Own Power. Randale Press Inc. Emmaus, Pa. ($8.95)

Periodicals

Source:	Material:
Senator Mike Gravel's Energy Newsletter 3317 Dirksen Bldg. Washington, D.C. 20510	
Solar Wind Newsletter West Allis, Wisc. 53214	
"Weekly A-nouncements" Bulletin ERDA Washington, D.C. 20545	
*Energy Reporter Federal Energy Admn. Room 2115 Office of Communications & Public Affairs Washington, D.C. 20461	Bi-Monthly N/C
*Alternative Sources of Energy, Inc. Rt. 2 Milaca, Mn. 56353	Published Quarterly--Most highly recommended periodical in Alternative Energy field.
Solar Age Rt. 515 Box 288 Vernon, N.J. 07462	Monthly periodical $20/yr.
Wind Power Digest Route 2, Box 489 Bristol, Indiana 46507	Quarterly periodical
Mother Earth News P.O. Box 70 Hendersonville, N.C. 28739	Bi-monthly periodical
American Wind Energy Assoc. Newsletter 21243 Grand River Detroit, Mich 48219	Quarterly periodical $15/yr.
Acorn Newsletter Midwest Energy Alternatives Network Governors State University Park Forest South, ILL. 60466	Bi-monthly periodical $4/yr.
Solar Energy Digest P.O. Box 17776 San Diego, Calif. 92117	Monthly Newsletter $27.50/yr.

Periodicals
(Con't)

Source:	Material:
New Earth Times P.O. Box 252 Winchester, Mass. 01890	Periodical
Energy Method Newsletter P.O. Box 1158 Lancaster, S.C. 29720	Periodical
Environment P.O. Box 755 Bridgeton, Missouri 63044	Monthly $12.75/yr.
*Energy & Power Journal	Contact: Dr. Leonard Sterry Supervisor Industrial Arts State Dept. of Public Instruction Madison, Wisc. 53703

Films

Source:	Material:
ERDA Film Library P.O. Box 62 Oak Ridge, Tenn. 73830	Catalog of Energy Films
Stuart Finley, Inc. 3428 Mansfield Rd. Falls Church, Virginia 22041	Series of 10 films on Energy and the Environment
Delatron 20370 Rand Rd. Palatine, Ill. 60067	Film on Wind Energy
James L. Ruhle & Associates P.O. Box 4301 Fullerton, California 92631	Educational Slide Programs on Energy & the Environment
Modern Talking Pictures, Inc. 2323 New Hyde Park Road New Hyde Park, New York 11040	Energy Films available
Energy Slides available from: Total Environmental Action, Inc. Church Hill Harrisville, N.H. Windworks Box 329 Route 3 Mukwonago, Wisc. 53149	
*Paul Gilson, Director FEA, Region V 175 W. Jackson Blvd. Chicago, Ill. 60604	Request volumes: ii. non-print, part one and iii. non-print, part two: 16 mm films. of "Energy Education Materials Inventory" prepared by Energy & Man's Environment, Inc. for the FEA.

Government Agencies

General Sources of Energy Information:

Publications Distribution
Fed. Energy Admin.
Washington, D.C. 20461

Division of Solar Energy
ERDA
Washington, D.C. 20545

Marilyn Edwards
Public Information
NASA-Lewis
Cleveland, Ohio 44135

ERDA
Tech. Information Center
P.O. Box 62
Oak Ridge, Tenn. 37830

FEA-Region V
175 Jackson Str.
Chicago, Ill. 60604

U.S. AEC
Technical Information Center
Oak Ridge, Tenn. 37830

Community Relations & Public Education
FEA
Washington, D.C. 20461

Dept. of HEW
Federal Regional Office
300 S. Wacker Dr.
Chicago, Ill. 60604

Government publications available from the Gov't Printing Office (GPO) may be obtained from:

GPO Milwaukee Bookstore
190 Federal Building
U.S. Courthouse
517 East Wisconsin Ave.
Milwaukee, Wisconsin 53202

Agencies (con't)

*Dave Whedon
Room 2111
FEA
Washington, D.C. 20461

Request: "FEA Information Directory"

Office of Communications & Public Affairs
FEA
Washington, D.C. 20461

"Energy Activities with Energy Ant" (Classroom Activity Booklet).

Park Project on Energy Interpretation
National Recreation & Park Assoc.
1601 N. Kent Str.
Arlington, Va. 22209

Energy Activity Guide", includes-bibliography, publications, teaching aids, films.

*Office of Low Income Weatherization Programs
FEA
Washington, D.C. 20461

"Project Retro-Tech" - a teacher's kit on home winterization.

Government Agencies (con't)

*National Tech. Information Service (NTIS) U.S. Dept. of Commerce 5285 Port Royal Rd. Springfield, Va. 22161	Tech. information, computer Searches, listing of bulletins available from Gov't. agencies.
National Wildlife Federation 1412 - 16th Str. N.W. Washington, D.C. 20036	"Energy: Selected Resource Material for Developing Energy Education Conservation Programs".
National Energy Information Center FEA Washington, D.C. 20461	Bibliographies available on Energy information.
Anne Bull Park Project on Energy Interpretation National Park & Recreation Assoc. 1601 N. Kent Str. Arlington, Va. 22209	Booklet available on "Community Information on Energy".
*Andrew Sampson FEA Washington, D.C. 20402	Energy Environment Materials Guide. 3 vol.
*Office of Public Affairs ERDA Washington, D.C. 20545	Request Energy History of the U.S. wallchart and user's manual.
*Paul Gilson, Director FEA, Region V 175 W. Jackson Blvd. Chicago, Ill. 60604	Request: "Energy Education Materials Inventory" prepared by Energy & Man's Environment, Inc. for the FEA.

FEDERAL ENERGY ADMINISTRATION

ANNOTATED LIST OF EDUCATIONAL MATERIALS AND PROGRAMS

1. TEACHING MATERIALS

A. Energy Ant Related Materials (Grades 1-3)
Energy Activities with Energy Ant. A coloring-game book to tell kids about energy and how to use it wisely. 28 pp. Available from Superintendent of Documents, U.S. Government Printing Office, Washington D.C. 20402. Stock No. 041-018-00054. Price $1.40. Revised Edition. Available fall 1975 from Consumer Information Center. Pueblo, Col. 81009. Limited copies free.
Third Grade Distribution. Revised sample copy and teacher guide to be distributed September 1975 to all third grade teachers. Cover letter to announce availability of 1.9 million copies for classroom use. FEA Public Affairs Distribution Office.*
Reproduction Plates. Available through Public Affairs Education Office.* $60.
Animated Film - 10 minutes. Color. Available December 1975 through Visual and Electronic Communications Office.*
Filmstrips. Two to accompany Activities Book. Available fall 1975.
Poster. 17 x 22. Color. Available August 1975. Public Affairs Education Office.* Limited copies free.

B. Energy-Conservation Teacher Aids and Reproducibles. (Grades 4-6) Educational package to include book and wall chart. Book to include 20 pages of teacher background on fossil fuels, energy problems, energy conservation, future resources; plus about 25 pre-printed spirit duplicating masters for student activity. Wall chart to summarize energy problems and conservation tips. 100,000 to be produced for December distribution. 75,000 to be sent to all elementary schools having 4-6 grades. Remaining available upon request from contractor, Public Affairs Education Office,* or the Office of Conservation Education * which funded the project.

C. NSTA Energy-Environment Materials. (Grades K-12) 3 Volumes (Source Book, Materials Guide, Mini-Unit Guide) written by National Science Teachers Association under contract with U.S. Office of Education. 14,000 sets currently being distributed free to science and social studies teachers and department heads by FEA Office of Conservation Education. Materials Guide Volume available free from Public Affairs Education Office.*

D. Energy: Understanding and Activities for Young People. (Grades 6-9) Also designed for youth groups: Scouts, 4-H. Discusses meaning of energy, sources, limitations, and conservation activities. Limited free copies available September 1975 through Conservation Education Office* and the Public Affairs Education Office.* Also for sale by GPO.

E. Energy Conservation Youth Training Program. Workshops for high school students and their teachers on energy conservation. Modeled on the "Energy Conservation Corps," piloted in New England last year. To be conducted in 12 States with all States having an opportunity to bid. Conservation Education Office.

II. GENERAL ENERGY EDUCATION MATERIALS

A. School Activity Brochure. Information on how to organize a local community energy conservation contest. Available fall 1975 from the Public Affairs Education Office.* Free.

B. Energy Reporter. Monthly, 8-page newsletter to acquaint key communicators and leaders with Federal, State, and local energy programs. Also contains energy education materials. Subscriptions through Community Relations and Education Office.* Free.

C. Speakers Kit, "Speaking of Energy." Designed to provide speakers with talking points and reference materials when addressing local, non-technical groups. Kit topics include: What is the Energy Problem?; Coal; Outer Continental Shelf; Alternate Fuels; Solar; Geothermal; Oil Shale; Utilities; Synthetic Fuels; and Conservation. Available from Margaret Sibley, Community Relations and Education Office.* Single kit free.

D. Six Slide Shows. Four for general audiences on energy conservation; one geared to owners of small businesses; and one a technical presentation on future energy sources. Available September 1975 through Visual and Electronic Communications Office.*

E. Six Mini Film Documentaries on Future Energy Resources. 3-minutes each. Available March 1976 through Visual and Electronic Communications Office.*

F. Two Films. 16 mm. 13 1/2 minutes each. One for consumers on how to conserve energy and money; another on energy conservation for those living on a fixed income in an urban environment. Available October 1975 through the Visual and Electronic Communications Office.*

Associations & Service Agencies

Source:	Material:
*National Science Teacher's Assoc. 1742 Connecticut Ave., N.W. Washington, D.C. 20009	3-Vol. pkg. of energy related materials; prepared by NSTA, FEA USOE Cost: $9.00
VITA College Campus Schenectady, N.Y. 12308	Info. on Energy in underdevelope countries.
*Thomas Alva Edison Foundation Cambridge Office Plaza Suite 143 18280 West Ten Mile Rd. Southfield, Mich. 78075	Request booklet: "Energy Conservation: Esperimen You can Do . . . From Edison."
Dr. Joe Coupland Director, Career Education Birmingham Board of Education Birmingham, Alabama 35203	Information on Energy Program at Birmingham Public Schools
*Director, Youth & Educational Activities Standard Oil Company (Indiana) Mail Code 3705 200 East Randolph Dr. Chicago, Illinois 60601	Information on Oil Energy Request activity guide for teach and students"Living with Energy"
Council of Better Business Bureaus, Inc. 1150 17th Str. NW Washington, D.C. 20036	Request booklet "Tips on Saving Energy No. 311-02217"
New England Solar Energy Association Box 121 Townshend, VT 05353	General Energy (Solar) Informati
The New Alchemists Box 432 Woods Hole, Ma. 02543	Alternative Sources of Energy, Information Available
American Wind Energy Assoc. 21243 Grand River Detroit, Mich. 48219	Information on Wind Energy
American Gas Assoc. Educational Services 1515 Wilson Blvd. Arlington, Va. 22209	Information and Educational Materials Available

Associations & Service Agencies
(Con't)

Source:	Material:
*The Energy Challenge Box 14305 Dayton, Ohio 45414	An activity master program abou our energy past, present, and future
Park Project on Energy Interpretation National Recreation and Park Assoc. 1601 N. Kent Str. Arlington, Va. 22209	"Energy - Who's Doing What?" State guide to energy activitie
N.J. State Dept. of Education Trenton, N.J. 08608	Booklet available "Energy Crisi A Teacher's Resource Guide".
National Coal Assoc. 1130 17th Str., N. W. Washington, D.C. 20036	Teacher's kit for Coal Energy.
Pennsylvania Dept. of Education Box 911 Harrisburg, Pa. 17126	"The Environmental impact of electrical power generations: Nuclear and Fuel." A minicourse secondary schools and adult edu tion. ($8.00)
Edison Electric Institute Educational Services 90 Park Ave. New York, N.Y. 10016	Educational Materials on Electr Energy
The Virginia Solar Energy Assoc. 314 Locke Lane Richmond, Virginia 23219	Solar Energy Information
IECL Clearinghouse Colorado State Library 1362 Lincoln Str. Denver, Colorado 80203	A bibliography of information available in Energy conservatio classified by state.
International Solar Energy Society (ISES) Florida Solar Energy Center P.O. Drawer N Cape Canaveral, Florida 32604	Source of information on Solar Energy
International Solar Energy Society American Section 12441 Parklawn Dr. Rockville, Maryland 20852	Bibliography on Solar materials and information. Reprint servic available.
*Technology For Society 206 Fryklund Hall UW-Stout Menomonie, Wisc. 54751	11 Instructional units on Altern tive Energy sources at $1.00 eac Highly Recommended.
Oregon Museum of Science & Industry 4015 SW Canyon Rd. Portland, Oregon 97221	Bibliography of energy material available.

Associations & Service Agencies
(Con't)

Source:

Solar Energy Industries Association Suite 632 1001 Connecticut Ave., N.W. Washington, D.C. 20036	Information on Solar Energy
Environmental Action Reprint Service 2239 East Colfax Ave. Denver, Colorado 80206	Energy information catalogue available
Education 201 East Colfax Ave. Denver, Colorado 80206	Energy information in education lists available

Colleges & Universities
(Con't)

Source:	Material:
Mobile County Public Schools P.O. Box 1327,, Mobile, Alabama 36601	"A Composite of Energy Curriculum Guides & Enrichment Materials" by M.A. Magnoli & J.M. Wert
Environmental Action Reprint Service University of Colorado at Denver 1100 4th Str. Denver, Colorado 80202	Catalogue on Energy information, reprints on major energy articles, very helpful people.
Research & Design Institute (REDE) P.O. Box 307 Providence, R.I. 02901	Excellent general source of information on various alternative energy forms.

Curriculum Guides can be obtained from various states by writing to Industrial Education Supervisors in care of the State Dept. of Education.

Manufacturers & Suppliers

Source:	Material:
Sun Power Systems, Inc. 1121 Lewis Ave. Sarasota, Florida 33577	Manufacturing equipment & supply information on Energy Systems, Specialty: Minto Engine.
Helion Box 4301 Sylman, California 91342	Manufacturing equipment & supplies
Solar Energy Co. P.O. Box 614 Marlboro, Montana 01752	Manufacturing equipment & supplies
Zomeworks Corp. P.O. Box 712 Albuquarque, N.M. 87103	Resource of equipment, information books, and supplies.
Physical Industries Corp. P.O. Box 357 Lakeside, California 92040	Manufacturers of Energy equipment supplies.
Solar Survival Harrisville, N.H. 03450	Grass roots organization for Alternative Energy Resources and house construction.
Wellesley Petroleum Lab Inc. 285-A Linden Str. Wellesley, Mass. 02181	Energy Information
Whole Earth Truck Store 558 Santa Cruz Ave. Menlo Park, California 94025	Source of Information & supplies
Union Carbide Corp. Battery Products Division 270 Park Ave. New York, NY 10017	Energy Storage devices
General Electric Battery 1441 NW 6th Str. Gainsville, FL 32601	Energy storage devices
Kahl Scientific Instrument Corp. P.O. Box 1166 El Cajon, California 92022	Scientific apparatus in Energy
American Wind Turbine Box 446 St. Cloud, FL	Manufacturer and supplier of Wind Power Systems.

Manufacturers and Suppliers
(Con't)

Source:	Material:
Environmental Energies 21243 Grand River Detroit, Mich. 48219	Energy & Environmental informatio
Mother Earth Box 70 Hendersonville, N.C. 28739	Source of information--books, periodicals, and supplies.
United Transparencies, Inc. Box 688 Binghamton, NY 13902	Teaching Aids in Power Electricit
American Heliothermal Corp. 3519 S. Tamarac Dr. Suite 360 Denver, Colorado 80237	Manufacture Energy equipment & supplies.
J.C. Young Co. 6721 E. Calle del Paisano Phoenix, Ariz. 85018	Manufacture energy equipment & supplies.
Rho Sigma, Inc. 15150 Raymar Str. Van Nuys, California 91405	Manufacture energy equipment & supplies.
Solar Science Industries, Inc. 10862 Tucker Str. Beltsville, Md. 20705	Book, information, curriculum packages.
Scott Engineering Sciences 1400 S.W. 8th Str. Pompano Beach, Florida 33060	Request: (PMH-C220) Fluid Power Designer's Lightning reference Handbook...Information on Fluid Power Systems.
Centerline Corp. Dept. 118 401 South 36th Str. Phoenix, Ariz. 85034	108-page directory of solar materials & equipment w/other int $7.50 Solar Energy Directory.
Resources Box 134 Harvard Square, Cambridge, Ma. 02138	Resources info. on energy areas
*Dynapower Associates RD 3 Litchfield, Connecticut 06759.	"Wind Energy & You" by Robert C. Griffin.
Earthmind 26510 Josel Drive Saugus, California 91350	Information on grass roots energy ideas.
Bucknell Engineering Co. 10717 E. Rush Str. South El Monte, California 91733	Literature & equipment.

Manufacturers & Suppliers (Con't)

Source:	Materials:
Energy Alternatives, Inc. P.O. Box 233 Leverett, Mass. 01054	Information, plans, and equipment
Solar Wind Co. P.O. Box 7 East Holden, Maine 04429	Equipment
West Wind c/o Geoffrey Gerhard 3095 W. Boyd Dr. Farmington, New Mexico	Wind & Electronics equipment
Zephyr Wind Dynamo c/o Earl L. Rich 29 Eagles Nest Dr. Scarborough, Maine 04074	Equipment and supplies available
Environmental Energies 21243 Grand River Ave. Detroit, Mich. 38219	Equipment & supplies
Natural Power Inc. Box 167-A4 New Boston, N.H. 03070	Equipment and information
T-K Solar Distributors, Ltd. 103 Plandome Rd. Manhasset, N.Y. 11030	Up-to-date files on companies in Solar Energy.
Mother's General Store P.O. Box 506 Flat Rock, N.C. 28731	Information & equipment
Energy Information Center Grant Road Newmarket, N.H. 03857	Energy Education Directory
Total Environmental Action, Inc. Harrisville, N.H. 03450	Source of Slide sets on Energy areas, info., books, plans.
Don Kent Instruments 725 Quincy Shore Dr. Quincy, Mass. 02170	Weather Instruments, Collections, Solar Systems.

Manufacturers & Suppliers
(Con't)

Source:	Materials:
Windworks Mukwonago, Wisc. 53149	Source of wind systems, info., slide presentations, plans, etc.
Edmund Scientific Co. Edscorp Building Barrington, New Jersey 08007	Source of energy equip., supplies and information.
*International Compendium 10762 Tucker Str. Beltsville, Maryland 20705	Source of info., books, and curriculum guides.
EXXON Research & Engineering Co. Public Relation Staff P.O. Box 639 Linden, N.J. 070[illegible]	Energy information available on request
McKnight Publishing Co. Bloomington, Ill. 61701	McKnight Power Experimenter Program.
*Megatech Corp. 29 Cook St. Billerica, Mass. 01866	Megatech Power and Energy Programs include both hardware and software for the Ind. Ed. Lab.

SOLAR EQUIPMENT MANUFACTURERS

This list does not indicate an endorsement
of any one of the manufacturers by us

Due to the continued growth in the industry, it is impossible for us to maintain a complete list of manufacturers. An up-to-date list can be obtained by writing: Solar Energy Industries, Directory & Buyer's Guide, 1001 Connecticut Avenue, Washington, D.C. 20036.

Aluminum Company of America
Lighting Industry Sales
1433 Alcon Building
Pittsburgh, PA 16219

Arkla Industries Inc.
Arkla Plaza
400 E. Capitol
Little Rock, Arkansas 72203

American Heliothermal Corp.
3515 Tamarac Drive
Suite 300
Denver, CO 80237

Brooklyn Thermometer Co., Inc.
90 Verdi Street
Farmingdale, N.Y. 11735

Deko-Labs
P.O. Box 12841
Gainesville, FL 32604

Delavan Electronics Inc.
14441 N. 73rd Street
Scottsdale, AZ 85260

F & K Service Co.
16824 - 74th N.E.
Bothell, WA 98011

Energy Systems
534 Crest Drive
El Cajon, CA 92021

Celotex Corporation
Tampa, FL 33622

FAFCO Incorporated
138 Jefferson Drive
Menlo Park, CA 94025

Fred Rice Productions Inc.
6313 Peach Avenue
Van Nuys, CA

Garden Way Laboratories
Charlotte, VT 05445

Gulf Thermal Corporation
2215 Industrial Blvd.
P.O. Box 2306
Sarasota, FL 33500

Hawthorne Industries Inc.
Solar Energy Division
1501 South Dixie
West Palm Beach, FL 33401

Heliotrope General
1869 Hidden Nesa Rd.
El Cajon, CA 92030

International Solar Thermics Corp.
Box 397
Nederland, CO 80466

Kalwall Corporation
1111 Candia Road
Manchester, N.H. 03103

Largo Solar Systems
2525 Key Largo Lane
Ft. Lauderdale, FL 33312

Solar Equipment Manufacturers (con't)

Northrup, Inc.
302 Nichols Drive
Hutchins, TX 75141

Olin Brass
(Roll-Bond)
East Alton, Illinois 62024

Ram Products
1111 North Centerville Road
Sturgis, Michigan 49091

Revere Copper & Brass Inc.
605 Third Avenue
New York, N.Y. 10016

Reynolds Metals Company
Richmond, VA 23261

Rho Sigma Incorporated
15150 Raymer Street
Van Nuys, CA 91405

N.R. Robbins & Son
D & J Sheet Metal Company
10055 N.W. 7th Avenue
Miami, FL 33150

Shell Oil Company
Public Affairs, Room 1541
P.O. Box 2463
Houston, TX 77001

Sky Therm Processes & Engineering
2424 Wilshire Blvd.
Los Angeles, CA 90057

J & R Simmons Construction Co.
2185 Sherwood Drive
South Daytona, FL

Sol Therm Corp.
7 West 14th Street
New York, N.Y. 10011

Solar Development Inc.
4180 Westroads Drive
West Palm Beach, FL 33407

Solar Dynamics, Inc.
4527 E. 11th Avenue
Hialeah, FL 33013

Solar Energy Components Inc.
1605 N. Cocoa Blvd.
Cocoa, FL 32922

Solar Energy Industries Assoc.
1001 Connecticut Avenue N.W.
Washington, D.C. 20036

Solar Energy Research Center
P.O. Box 17776
San Diego, CA 92117

Solar Energy Systems
One Tralee Industrial Park
Newark, Delaware 19711

Solar Energy Systems
1243 S. Florida Avenue
Rockledge, FL

Solar Water Heater Company
P.O. Box 341872
Coral Gables, FL 33134

Solarex Corp.
1335 Piccard Drive
Rockville, Maryland 20860

Solaron Corp
Stapleton Field Industrial Park
4850 Olive Street
Deuver, CO 80022

Solarvak
Solar Systems Inc.
1802 Dennis Drive
Tyler, TX 75701

Spectro Lab
12500 Gladstone Avenue
Sylmar, CA 91342